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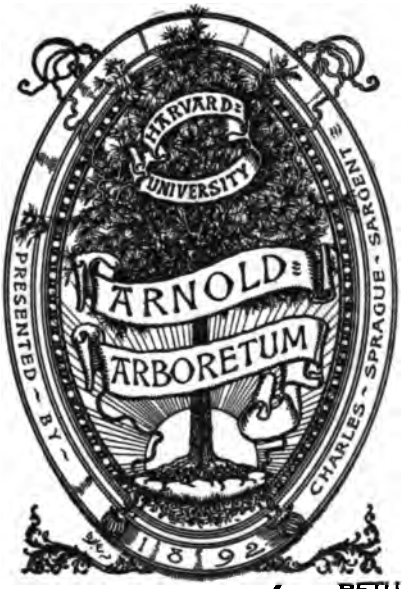

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THE FORESTER

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THE FORESTER

A PRACTICAL TREATISE
ON THE PLANTING, REARING, AND GENERAL MANAGEMENT OF FOREST TREES

BY

JAMES BROWN

WOOD MANAGER TO THE EARL OF SEAFIELD, AND SURVEYOR OF
WOODS IN GENERAL

THIRD EDITION—ENLARGED

WILLIAM BLACKWOOD AND SONS
EDINBURGH AND LONDON
MDCCCLXI

PREFACE.

The Author desires to express to the public his gratification at the favourable reception of the two former editions of "The Forester," as it indicates that the spirit of improvement is rapidly progressing among all interested in Arboriculture. With a view to render the book still more worthy of continuance in public favour, it has been carefully rewritten, and many new sections upon important subjects added, for the purpose of making it still better adapted as a complete guide in all forest operations; in short, it has been so much enlarged and improved, that it may be considered in every respect a new book.

Since the appearance of the Second Edition in 1851, the Author has been very extensively employed by landed proprietors in all parts of the country, in surveying and reporting on the present state and future management of plantations, and of grounds adapted for planting. His observations and experience have thereby been very much extended, inasmuch as each district usually presents some distinctive and peculiar features, arising from the nature of the soil, aspect, and elevation above the sea: and the whole practical results from this extended and varied field of operations have been embodied in the present edition of "The Forester." In it, as in the former editions, the Author has confined himself entirely to the results of his own experience in forest operations; and his first aim has been that of making his work plainly and practically useful as a forester's guide.

As the Author continues to survey woodlands, and to report on them, he has considered it judicious to devote a section of this book to an explanation of his mode of Reporting. The subject of keeping the Forest Accounts has also been for the first time taken up in the present edition; and a section has been added containing a complete system of Forest Book-keeping, with examples of all the various Books, and full explanations regarding them. This will be found in the first section of Chapter XIII.

With these brief remarks, he again commits his work into the hands of the public.

17 Minto Street, Edinburgh,
Nov. 30, 1860.

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THE FORESTER.

CHAPTER I.

SECTION I.—A SHORT OUTLINE OF THE HISTORY OF ARBORICULTURE.

1. There can be little doubt that the culture of trees occupied the attention of man from the earliest ages. Though it may seem fanciful to carry back the art to the progenitor of our race, yet, when we consider how certainly these noblest growths from the soil must have attracted his wonder and excited his admiration, and how many of them must have contributed to furnish him with the means of subsistence, it is scarcely an extreme assumption that he may have devoted some degree of care to their cultivation; and if the art of gardening is entitled to claim its origin from the garden of Eden, that of forestry may, on similar grounds, claim the same antiquity.

2. Passing from this early period, we learn from the history of Solomon, king of the Jews, that he was well acquainted with the nature of plants; and we may safely infer that, in the extensive gardens and pleasure-grounds of that wealthy and intellectual sovereign, there had been no small attention paid to the rearing of trees both for ornamental and useful purposes. From his example, and from his ability to introduce many different species of trees from the countries to which his ships sailed, he would establish tree culture to a considerable extent among his nobles and others having estates in his provinces; so that the deduction from this is, that in Judea arboriculture was practised and understood at a comparatively early period.

3. The Greeks, who were, in their day of power at least, a highly intellectual people, and who lived for the most part on a fertile soil and in a salubrious climate, would, at an early period in their history, appreciate the advantages of tree culture both for useful and ornamental purposes. It is to be inferred, therefore, that they too were arboriculturists to a pretty large extent.

4. But of all the nations of antiquity the Roman was the greatest in the cultivation of trees; and of this we have ample proof from the writings of Pliny. In fact it is well-nigh certain that the Romans were the first to introduce foreign trees into Britain, as well as the first to teach our forefathers in regard to the general cultivation of this class of produce. They were, in the common sense of the word, Foresters; for we learn, from the author named above, that they planted and reared coppice woods for poles to support their vines, and for various other useful purposes, and that they planted willows for basket-making and other wicker-work. It is also stated that they had forests on their hills, from which they cut timber for building purposes.

5. At what particular period in the history of Britain tree culture was first commenced we have no reliable information; but there can be no reasonable doubt that the Romans were the first to introduce the art, at least to any important extent. It is but reasonable to suppose that, previous to the invasion by the Romans, the inhabitants of both England and Scotland were too rude and ignorant, as well as too much harassed by their party wars, to be able to benefit themselves by planting trees to any extent.

6. The first reliable account we have in reference to the planting of trees in Britain, is that given by Holinshed, who states that, in the reign of Henry VIII., "plantations of trees began to be made for purposes of utility." In 1523, one Fitzherbert wrote a work on planting.

7. In *Brit. Topo.*, p. 61, Gouch says that, before the year 1597, Gerard had 1100 different plants and trees in cultivation.

8. From the date last noted up to 1664, when Evelyn published his *Sylva*, many trees were introduced into England, and cultivated by private proprietors in their gardens and on their pleasure-grounds, and especially on those at Fulham Palace, the seat of Bishop Compton.

9. Evelyn's *Sylva* is a voluminous work on the subject of planting and rearing trees, and his quaint way of recording his views is rather amusing. He was a chief authority on arboriculture in his day, and in his writings he enters very fully into the modes which were by him adopted in reference to planting, pruning, and thinning. From the information contained in his work, many proprietors would no doubt plant pretty extensively; and, as he was a man of very considerable natural taste and ability, he would be consulted personally on the subject of which he wrote so much. He seems to have been very fond of clipped specimens of evergreens, which were in great fashion in his day; but, from his writings in general, it is evident that he was more a promoter of the planting of valuable timber plantations than of gardening or ornamental planting.

10. From the fact of the Botanic Gardens at Edinburgh having been founded by Dr Balfour in the year 1680, it is to be inferred that about this time not only was planting in progress in Scotland, but also that a very considerable taste for botanical pursuits had risen up in the country. From the catalogue of plants grown in these gardens about the time we refer to, and published by Mr Sutherland, their curator, in 1683, it would seem that the cedar of Lebanon had been introduced into them that year.

11. After the year 1700, it would seem that the greater number of our large landed proprietors, both in England and Scotland, began to plant on a somewhat large scale. Brown—well known by the appellation, "Capability Brown"—laid out and planted many places between the years 1730 and 1760. Perhaps Syon House, one of the seats of the Duke of Northumberland, may be stated as the most important of these in point of variety of kinds planted. At this place there are many fine specimens of old trees, of all the important sorts known in the country at the time of their being planted.

12. From gleanings made from old writers on the subject of planting, it is certain that, in Scotland, tree culture had commenced to some extent about the middle of the seventeenth century. From Dr Walker's Essays we learn that the lime-tree was planted at Taymouth in 1664, the silver and the spruce firs at Inveraray in 1682, the black poplar at Hamilton in 1696, the horse-chestnut at New Posso in 1709, the Weymouth pine at Dunkeld in 1725, and the larch at the same place in 1741, the English elm at Dalmahoy in 1736, the Norway maple at Mountstewart in 1738, and the cedar of Lebanon at Hopetoun in 1743. These gleanings prove that a taste for the cultivation of the various sorts of trees had sprung up among the landed proprietors of Scotland at a comparatively early period.

13. In the year 1700 there were upwards of 1000 acres enclosed and planted in the New Forest, Hampshire.

14. It would seem that in Scotland, among the first who planted trees in large masses for profitable use, was Thomas, Earl of Haddington. He began to plant extensively at his seat, Tynninghame, in East Lothian, in 1705. This nobleman wrote a treatise on forest trees, and published it in 1733. In his work he says, "I will be bold to say, that planting was not well understood in this country till this century began. I think it was the late Earl of Mar that first introduced the wilderness way of planting amongst us; and very much improved the taste of our gentlemen, who very soon followed his example."

15. The wilderness way of planting referred to by the Earl of Haddington, is simply a plantation with openings left through it, as vistas from some given point, taken, no doubt, from the English style of the time.

16. About the year 1730, the planting of trees in large masses began to be very generally practised all over the country, both in England and Scotland. I state this from my own observations on the plantations which I have inspected in the different parts of the kingdom.

17. Shortly after the date last quoted, from the great demand there was for young trees for the purpose of useful planting, nurseries began to be established for their culture. It is to be inferred from Walker's Essays that public nurseries were established in Scotland, for the rearing of forest trees, between the years 1730 and 1760.

18. About this time one Boutcher, an Edinburgh nurseryman, wrote a treatise on the rearing of forest trees.

19. The Kew Gardens were established in 1760, and in them there were collected specimens of all known trees; but a considerable number of years previous to this date there were several extensive nurseries in England, in which were reared not only forest trees, but also all the foreign plants known at the time.

20. As soon as public nurseries had become so plentifully and extensively established in the country as to cause competition, and consequently to produce a supply of young trees at a reasonable rate, proprietors commenced to plant on a large scale; and it will be found that a very large portion of the existing plantations of Britain were planted in the latter part of the last century and the beginning of the present one.

21. In England there are few extensive proprietors who have not a large proportion of their older woods of from sixty to eighty years' standing, and of their younger ones from forty to fifty years, indicating that a large amount of planting had been undertaken and performed betwixt the years 1777 and 1817.

22. The same remarks are applicable to the age of the greater portion of the existing plantations in Scotland. For, although the planting of trees for profitable purposes was undertaken at a much earlier date in England than in Scotland, still the proportion of plantations of this description was but small in England previous to 1777, and I think it will be found to hold good that the larger proportion has been made since the date last named; and in making these statements I do so from my own observations.

23. In the latter part of the last century, and in the beginning of the present one, the chief planters in Scotland were the Duke of Atholl, Lord Breadalbane, and Sir J. Grant of Strathspey. No doubt others planted also extensively in a comparative sense, but the plantations of any one of those just named far overbalanced those of any other private proprietor, perhaps, in Britain.

24. After 1817, and until but lately, it would seem that comparatively a small extent had been planted. This circumstance in the history of Arboriculture is, in my opinion, to be accounted for chiefly from the fact that a large portion of the plantations which had been made previous to the date last named had not succeeded to expectation, and that, consequently not only the proprietors who had so nobly set an example in this respect, but also others who purposed to plant, were deterred from their praiseworthy exertions to improve the country, from seeing the generally unremunerative success which followed so great an outlay of capital.

25. That partial failure should have followed upon extensive planting at a time when the advantages of drainage and thinning were not properly understood nor acted upon, is not to be wondered at. But gradually, and as experience was obtained on the subject, light was thrown on it, and a new era was brought about. This era, I should say, may be dated from about the year 1830, as previous to this period few had practised drainage to any important extent on land before planting trees upon it, and as few had understood the necessity and advantages of judicious and systematic thinning.

26. After the year 1830, when the partial drainage of waste and other lands began to be practised for the planting of forest trees, and when even the imperfect system then adopted was found to operate in a beneficial manner on the health of the crop, many proprietors, especially in Scotland, commenced to plant largely.

27. Some time previous to the year 1830 the advantages of thinning young plantations in a decided and systematic way had become somewhat understood, but even then much remained to be learned by those who had the management of them ; and even still it is only on a very few places of note that thinning on a sound principle is understood and acted upon.

28. Within the memory of the writer vast advances have been effected in the mode of cultivating trees, from the results of which proprietors are now expending, with full confidence of realising valuable returns, large amounts in the improvement of their properties by planting ; and as the subject has now become one of the greatest importance to this country, in a profitable point of view, it cannot be doubted that ere long still greater improvements will be brought out in reference to it, and, consequently, that still greater advantages will arise from them than have yet been experienced.

29. Since the beginning of the present century, a large number of new sorts has been added to our list of forest trees, chiefly from the mountainous regions of India and America. Many of them, especially of the pine and abies tribe, are doubtless destined to become of very great importance to the country, both in a useful and ornamental point of view.

30. Several public-spirited proprietors have recently planted collections of the newer sorts of trees upon their grounds, in order to test their hardiness and suitableness to our climate. Such collections are generally termed *arboretums*. From such praiseworthy exertions there is no doubt that ere long we shall be in possession of ample experience in regard to the characteristics of the several species, and, consequently, will be able to discard such as may be found unsuitable, and to promote the increase of such as are likely to be of advantage to our plantations.

31. Judging from such undertakings in regard to the introduction of new sorts of trees, from the now understood beneficial effects of judiciously thinning plantations, and from the large extent of land now being put under them, it does not admit of a doubt that arboriculture, as an art, is fast attaining that degree of perfection which its importance demands, as a branch of rural economy, in an island country like Britain.

SECTION II.—IMPORTANCE OF WOODLANDS IN GREAT BRITAIN.

32. The cultivation of woodlands, as a source of profit to the proprietor, is not of equal importance to the welfare of every country. In any country thinly inhabited by man, or in a country newly taken possession of by civilised man, such as America, New Zealand, or Australia, natural forests prevail in great abundance; indeed, often to such an extent that the new settlers find forests of timber trees to be a mere nuisance, and are very frequently obliged to destroy them, in order to have the land put under a crop more profitable for their purpose for the time being. I am aware that this is frequently the state of things relative to forestry in many newly settled districts of a newly discovered country, but it is ultimately a very unprofitable way of going to work, even in a country where natural forests prevail; for, were forestry maintained as an art among new settlers in such countries, much profitable and useful timber might be retained upon the newly improven lands, which might prove of great advantage to generations coming after, as well as to the settlers themselves; and, as an example of this, witness the scarcity of useful wood in some parts of the United States of America at the present day. And from this I mean to infer, that the raising of artificial forests in any newly inhabited country is not of primary importance to the settlers; but the retaining a part of the natural forests is of great ultimate importance to them, and provision should be made by the laws of such a country for preserving a proper quantity of the natural forests for ultimate good. But the case is altogether different in an old-established country like Britain, where the natural forests have for centuries

disappeared, and where the inhabitants must either buy timber from other countries, or raise it upon the land in the form of a crop.

33. There is no country upon the face of the earth which would be more benefited by an extended system of forestry than Britain. The navy demands skilful forestry and extending of woodlands in order to support it; the present advanced state of agriculture demands the same thing; and the general welfare of the whole country has a right to it. Relative to each of these heads it will be necessary to make a few observations.

34. First, The navy of Great Britain demands skilful forestry and extending of woodlands in order to support it. Many have argued that "there is no need of being apprehensive of wood becoming scarce for the supply of the navy, so long as we can procure plenty of the best of wood for shipbuilding from foreign countries, in addition to the large supply growing in the Government forests in the different parts of England." I cannot agree with those who reason in such a superficial manner. When we reflect upon the enormous quantity of oak wood consumed in the building of one man-of-war ship, the conclusion is forced upon us that, as a nation, we would be wrong in the extreme were we to neglect the rearing of a supply of timber for the purpose, and to depend upon foreign supplies, which at best must always be precarious. It takes fully one hundred and fifty thousand cubic feet of timber to build a seventy-four gun-ship; and allowing, upon an average, that the trees in an oak forest, when arrived at maturity and ready for shipbuilding, stood at the distance of about thirty feet from each other, we could only have about fifty trees from an acre; and supposing that the same trees were from one hundred to one hundred and twenty years old, there would probably be about seventy feet of timber in each at an average; consequently, we see from this calculation, which is pretty near the truth, that no less than the matured crop of forty-four acres of woodland, or two thousand two hundred full-grown trees, are required for one such ship.

35. It is stated upon good authority, that there is very little more than one-sixteenth part of the timber used at the royal dockyards supplied by the Government forests, extensive as they are considered to be; consequently the remaining quantity, excepting what may be purchased from private landholders in the country, must be furnished from abroad; and from this it is evident to every man who has the welfare of his country at heart, that the produce of the Government forests, in order to answer the end in view, ought to be increased tenfold.

36. The policy of depending upon foreign countries for the supply of timber for such a great work as our navy is therefore ridiculous in the extreme, and more particularly when we have so much waste land in the

country, of excellent capabilities for the growing of timber, the greater part of which is inaccessible to the plough of the farmer, and therefore would by no means diminish the available quantity of land which might be improved for the increase of food for our population.

37. Another important question naturally arises here—namely, Are the natural forests abroad in a state likely to supply the great and increasing demands for the British navy? We must answer in the negative. Every country upon the face of the globe, with which England has ready communication, is rapidly progressing in the march of improvement; and it is well known that, as civilisation makes progress, and agricultural pursuits extend, natural forests diminish, and eventually become extinct—as is the case with ourselves at the present day; and at the same time, as civilisation increases, the demand for timber increases also. Now we must infer from this that each country, as it becomes more refined in the arts and comforts of life, will have at least enough to do with its own home timber, and will require to encourage forestry in order to keep good its own supply.

38. Let us consider the state of America relative to timber, as an example of what I have above asserted, and I am of opinion that in a very short time many other countries will be in like condition. A. H. Hillhouse, in his translation of Michaux's *North American Sylva,* says: "Though three-fourths of our soil (North America) are still veiled from the eye of day by primeval forests, the best materials for building are nearly exhausted. With all the projected improvements in our internal navigation, whence shall we procure supplies of timber fifty years hence for the continuance of our marine? The most urgent motives call imperiously upon Government to provide a seasonable remedy for the evil."

39. I may further add that, at the present day, the United States are depending upon the wooded regions in Canada for the supply of their useful timber; and in that country, where so much wood is necessarily consumed for fuel, the supply cannot meet the demand for a great many years; and it is now the opinion of many practical men, that in a few years wood will not only be very scarce, but at the same time very dear—much beyond any price we can form any adequate idea of at the present day. But it is to be hoped that these matters will undergo serious consideration, in order that such a state of things may be in a great measure avoided; and the remedy is, an improved and extended system of forestry throughout the whole of our island.

40. The present advanced state of agriculture in Great Britain demands a skilful and extended system of forestry.

41. It is allowed by all who have given their attention to the improvement of waste lands in our country, that the rearing up of healthy plantations

improves the general climate of the neighbourhood; and not only is the climate improved to a great degree, but the very soil upon which forest trees grow is much improved by the gradual accumulation of vegetable matter from them.

42. I would ask this plain question, What is the natural cause of so much waste land being found in the north of Scotland, and in many parts of England? Can it be denied that it is the want of trees to give shelter? Why is it that proprietors of land complain so much of great tracts of it being worthless, growing nothing but the inferior grasses, mosses, rushes, and heaths, upon which even one sheep cannot find food upon two acres? Is it not for the want of plantations to give shelter? And now that Government is very wisely granting loans of money for the improvement of such lands, we may naturally expect to see great things done in this department in the course of a very few years. Now that the agriculture of our country is improving rapidly, forests and extensive plantations ought to go on in the same degree—not keeping behind, but rather in advance; for what profit will be derived from a superior system of cultivation in the land, if the fields we cultivate be not sheltered from the evil effects of our uncongenial climate by healthy and judiciously laid-out plantations? In the improvement of all waste lands there ought to be at least one-tenth part of the same planted, in order to give shelter; and wherever this is not attended to, disappointment is the natural result: for if this be not done as the improvement of waste lands advances, such will, without doubt, be comparatively unproductive; and very likely, from the holder of such land finding that it will not pay him, he will allow it to fall back into its original state of nature.

43. The general welfare of the country demands an extended and improved system of forestry.

44. If the population of Britain is doubling itself every fifty years, where is our supply of food to come from, in one hundred years hence, if the waste land be not improved by forestry? This is a question which demands serious consideration, and must, upon reflection, point out the influence of planting upon the general welfare of the country. If any piece of waste land, after being drained and ploughed, will yield six bolls per acre, in a state unsheltered by forest trees, the same land will yield at least ten bolls per acre if judiciously sheltered by them; and from this we are bound to conclude, that the inhabitants of the country have a right to expect that such a state of things should exist, seeing that in so many cases they are compelled to leave their native country from the want of such a state of things, and expend their money upon works of the very same nature in a foreign country. Were proprietors of waste land to lay off the same in a judicious

manner with plantations, the money which is now carried away by industrious men to America, &c. would be spent at home upon their estates.

45. And not only is the community at large benefited by an extended system of improvement, but every proprietor who will plant forest trees, not only gives shelter to his fields, but, at the same time, greatly enhances the value of his estate, as will be treated upon in the proper place.

SECTION III.—SUITABLENESS OF THE SOIL AND CLIMATE OF GREAT BRITAIN TO THE GROWTH OF TREES.

46. We think it may be stated that there is no country in the world so well adapted to the growth of a great variety of valuable timber trees, of foreign origin, as our island.

47. Its soil is variable, and hence its general adaptation to the healthy development of very many sorts of trees from all the temperate regions of the globe; and from our winters being generally milder than those of many continental countries considerably lower than our latitude, we succeed in cultivating, without any artificial protection, many sorts of useful plants which are not found to stand the winters of the continents of North America and central Europe without artificial means being used.

48. The comparative nearness of all the parts of our island to the softening influences of the sea is no doubt the cause of this; for the ocean invariably preserves a more uniform temperature than the land. Hence, from our island position, we enjoy a milder climate than the inhabitants of inland regions under the same parallel of latitude; and hence the temperature at London is lower in summer than at Paris, and higher in winter, although the former place is in a more northern latitude than the latter.

49. In Milner's *Gallery of Nature*, it is stated that, "at the port of Salcombe, in Devonshire, called the Montpelier of the north, an agava flowered in 1774, after having lived twenty-eight years without being covered in winter; and in some parts of that district, the myrtle, the *Camellia japonica*, the *Fuschia coccinia*, the *Buddleia globosa*, pass the winter without shelter in the open ground, and orange-trees are seen on espaliers, only sheltered, as at Rome, by means of matting." The same author states, that "it is a well-known fact that, in travelling from the equator northward to the pole, the cold increases in a slower ratio about the meridian of London than in any other part of the world;" and that "the climate of western Europe in general is milder than that of countries under the same parallel at its eastern extremity, or in Asia, or in America.

50. The uniformity of the temperature of our climate is very remarkable

as compared with that of other parts of the world; and from this we have an undoubted advantage over almost all other nations in regard to the cultivation of trees not natives. I shall refer to a few examples of places in illustration of this point. Humboldt says: "At New York, we find the summer of Rome and the winter of Copenhagen. At Quebec, grapes sometimes ripen in the open air, whereas the winter is that of Petersburgh during which the snow lies five feet deep for several months, and travelling is performed in sledges, frequently on the ice of the St Lawrence. At Pekin, in China, where the mean temperature of the year is that of the coasts of Brittany, the scorching heats of summer are greater than at Cairo, and the winters as rigorous as at Upsal."

51. But, apart from all such mere deductions as regards the mildness of our climate, we have the more convincing proof of our own experience on the subject; for there are not many countries in the world from which we have not brought plants, and cultivated them either as useful or ornamental; and a large portion of them, not by confining them in an artificial climate, but by planting them in the open ground, and exposing them to all the changes of our climate. For example, from the south of Europe we have the lime tree and black poplar; from Corsica, the *Pinus laricio;* from Austria, the *Pinus Austriaca;* from Germany, the common larch; from the north of India, the horse chestnut; from Eastern India, the *Cedrus deodara;* from Asia Minor, the sweet chestnut; from the United States, the *Magnolia grandiflora* and the tulip tree; from Canada, the *Populus Canadensis;* from California, many useful pines; and from Chili, the *Araucaria imbricata.* These few examples, out of the many that could be adduced, are enough to show that both the soil and the climate of Great Britain are admirably adapted to the growth of trees; and not only to those which are natives of Europe, but also to such as are natives of temperate regions in all parts of the world.

52. Notwithstanding, however, that the soil and climate of our island are generally thus suitable to the healthy growth of a great variety of useful trees, natives of foreign countries, it must not be understood that all parts of it are alike in this respect, as there is, in the length and breadth of Great Britain, a very considerable diversity in regard to both soil and climate; and this is, of course, to be expected from the different geological formations, as well as from the different degrees of latitude and relative elevations of land embraced betwixt Land's End and the Pentland Firth.

53. The great central and eastern plains of England, together with the Valley of the Severn, may be classed as the first in order for the growth of the most valuable sorts of trees to first-rate magnitude in this country, and the plains of York and Cheshire as the second; while the great table-lands

situated to the south-west of these districts may be characterised as third-rate, as compared with the others, for growing trees of the hard-wooded sorts, and the table-lands of the north of England and the south of Scotland, embracing that district of the island from the river Tees on the south to the Frith of Forth on the north, as fourth-rate, both in respect to soil and climate.

54. Lying partly on the north of the Frith of Forth, and partly on its south side, there is the narrow central plain of Scotland, stretching from Glasgow along both sides of the river Forth to Edinburgh, and thence northwards as far as Montrose, which, for the growth of trees, may be classed as of fifth-rate capabilities.

55. The greater part of the country situated to the north of the central plain of Scotland, both from its geological formation and from its relative altitude, is, generally speaking, unsuitable to the growth of any trees to large and valuable dimensions other than the pine and fir tribes; but these on this district of the island grow to even more valuable sizes than in the more southern parts of the island. Hence this may be truly styled the pine-growing region of Britain.

56. The larch forests of the Duke of Atholl at Dunkeld, and those of the Marquess of Breadalbane at Taymouth, may be cited in illustration of the suitableness of the soil and climate of those districts in particular, and of the West Highlands in general, to this most valuable tree; and the pine forests of Lord Seafield, in Strathspey, are evident proofs of the suitableness of the soil and climate of that part of the island to the growth of the Scots pine to its most valuable dimensions.

SECTION IV. — THE EFFECTS OF PLANTING, AND ITS INFLUENCE ON THE IMPROVEMENT OF THE SOIL AND CLIMATE OF A COUNTRY.

57. The first and perhaps the greatest effect of judicious planting is that of shelter to the country in its neighbourhood.

58. The second, and perhaps not the least important effect of planting trees in masses, is that of ornament.

59. When we compare the agricultural and picturesque advantages of a part of the country which is judiciously clothed with trees, with those of a part which has either been stripped of its crop of timber, or which has never been planted at all, the difference is very striking, even to the most common observer. In the former all kinds of crops are sheltered, and consequently grow luxuriantly, while in the latter the crops are sub-

ject to the extremes of cold and storms in winter, as well as of the sun's heat in summer.

60. It is therefore an undoubted fact that the presence of trees in any country has the effect of softening the storms and colds of its winters, as well as of softening the heats of its summer, and preventing too great evaporation of moisture from its surface, which inevitably takes place under a contrary state of things.

61. On this subject, we think it desirable to give a quotation from the *Gardeners' Chronicle* of the 2d April 1859, in which Dr Lindley, in his leading article, states, " that the effect of felling large quantities of timber is to diminish atmospheric moisture is notorious. To say nothing of the altered climate of these islands consequent upon the removal of our superfluous ancient forests, there are other and more recent cases which may be safely quoted. On the 27th February 1856, the subject was brought before the *Chambre des Députés*, by M. LADOUCETTE, deputy for the Moselle, who adduced numerous modern instances of humid countries having become arid in consequence of the immoderate clearing of forests. He cited Fontenay and Provence as places where it has led notoriously to wells and pits becoming dry, and called as evidence to the same effect the Prefect of the Haute Garonne, who asserted that in the whole of the Eastern Pyrenees and the Henault, the destruction of timber had been calamitous, temperature became higher, wells and water-courses diminished, while the dryness of the climate was greatly increased. Similar evidence was collected by Professor Laurent, of Nancy, of whose numerous statements the following may be taken as specimens. After referring to the desolation brought upon so many of the nations of the East by the loss of their forests—upon Babylon and Nineveh, Thebes, Memphis, Carthage, Palestine, and the Troad—he concludes by quoting similar examples in the recent history of France. In the Vosges the destruction of forests has gone too far, so that the humid vapours so necessary to plants have diminished, while the soil has become arid, and inundations frequent. In the department of the Gard it did not rain in 1837 for nine months. Such a dryness was not in the memory of man: the people ascribed it to the successive destruction of the mountain forests. The town of Nismes, whose name is derived from the forests that surround it, exhibits little except sterile wastes. At Berjiers 300 members of the Agricultural Society reported, in 1797, that the vast forests which once sheltered that place having disappeared, the loss of the olive crop is the inevitable consequence. The authorities of the Isère represented, in 1793, that the destruction of forests had altered the temperature, augmented dryness, and seriously affected the crops. As to wells and pits, their supply, too, had, before 1838, been most seriously

diminished. Violent storms and torrents of rain, indeed, fell from time to time, but they ran off the land without soaking into it, and the subterraneous reservoirs gained nothing. In short, ancient mill-streams were gone, or flowed only in winter; and the old head waters of the river affluents had disappeared in places where the woods had been grubbed up. The general conclusion of this well-informed writer is expressed in the following words: "By the destruction in France of a great extent of forests, in order to replace them by cultivated fields, the temperature has become very irregular; heavy rains, storms, and dryness have each done their work upon the soil, and made crops every year more and more uncertain."

62. These statements, then, go to prove that too great an extent of plantations in a country is conducive to extraordinary humidity in it, inasmuch as very large masses of woods prevent the sun's rays from penetrating to the land and warming it; 2d, That too small an extent is conducive to the contrary state of things, to a degree hurtful to vegetation; and, therefore, 3d, That a judicious proportion of the land of any country being under woods is absolutely necessary for the welfare of all branches of its rural economy.

63. The proportion of land which ought to be under trees in any part of a country must always depend upon the character of its surface, whether that may be flat or hilly, low-lying or much elevated, as the higher lying and more elevated a district is, the greater extent of timbered land is necessary on it.

64. Having thus shown that judicious planting has a very decided influence on the improvement of the climate of a country, we now come to make some remarks on its influence to improve the soil; and on this branch of the subject it may not be too much to state that any piece of land, not properly agricultural, but adapted to the growth of timber only, however good it may be previous to its being put under a crop of trees, must be very much better, chemically speaking, after such a crop shall have been reared on it and removed from it, and must thereby be rendered more suitable for agricultural purposes than if it had remained without any such crop.

65. This results from the large amount of vegetable matter which trees annually deposit on the land occupied by them, as well as from their roots penetrating deep into it, and consequently dividing its parts and opening it up to the action of air and water.

66. In proof of this I may allude to the very rich soils of the American continent, which have been for the greater part formed from the deposits of vegetable matter from successive crops of trees that have grown on them. And with these let us compare the sterility of such parts of a coun-

try as have not been occupied by trees. By such a comparison we are at once forced to admit that in the economy of nature trees perform a very important part in improving the land on the surface of the globe, and in rendering it serviceable for cultivation by man.

67. But in this respect we need not go far for proof, inasmuch as on our own island we have abundant evidence of the fact that trees vastly improve the land on which they grow.

68. On the flats and hollows of this country, everywhere the land bears evident proof of having been occupied by trees at an early period, and that it is chiefly from this, and from their having decayed and rotted upon them, that their soil is now so fertile. In the Highlands of Scotland, perhaps, this fact is more evident than elsewhere, as there, even at this day, the best of the land is found in the hollows and on the lower slopes of such of the hills as have on them either the remains of trees or as are still under them.

69. But, besides these proofs on this point, I may state that I have in our own day seen large tracks of waste land planted, which, although previous to its having been put under trees was thin of soil and poor, gradually became comparatively good land, and this from the decayed leaves falling from trees growing upon it, and from their shade causing the natural plants of the surface to decay and incorporate with the original soil.

70. Still farther, there can be no doubt that judicious planting on an extensive scale is destined to be the great means of improving the soil and climate of all the mountainous and higher lying parts of Britain, where, at the present day, from our want of sufficient knowledge for profitable improvement, little good can be got of them other than as sheep pastures and deer preserves.

71. I state it here, as my general and broad opinion on this subject, that the time is fast approaching when the proprietors of the north of England and of the north of Scotland will be able, from the proper and scientific application of planting, to rear profitable crops of timber at a much greater elevation than is now considered practicable, and that from this cause they will also be able to cultivate profitably their now waste lands to an incredible extent and elevation.

SECTION V.—THE OBJECT OF PLANTING.

72. Generally every proprietor, in planting trees on his estate, has some definite object in view for the work. This may be either to give shelter to

his farms, to shut out some unpleasant object from his dwelling-house, or to produce ornamental effect to the landscape; but the great and ultimate object is that of its being profitable as a crop in a money point of view. In short, the object may be one or other of these points, or it may be all of them combined, according to the circumstances of the case.

73. On small properties situated in naturally level, fertile, and sheltered parts of the country, where arable land is more immediately remunerative than woodland to the proprietor, he can have no object in planting trees other than for ornamental effect.

74. The case, however, is somewhat different in regard to the proprietors of comparatively extensive and hilly estates, as on such, besides effect, it becomes a point of wise and profitable management to plant on the higher districts, with the view to ameliorate the climate of the lower, to improve the soil of the hills, and by the timber crop to enhance the general value of the property.

75. But with the proprietors of extensive hill estates the great object in planting must be that of rearing a crop of trees on land otherwise unfit for profitable use, and therefore that of deriving from it a source of income which could not, generally speaking, be otherwise obtained from such land.

76. The foregoing remarks are only applicable to the subject under notice, as taken in the broadest point of view, as, specifically, each branch of it diverges into many points, each of which may become expedient in practice, according to circumstances. For example, a proprietor having in view the planting of trees for shelter to his farms may at the same time have in view to deal with them as hedgerow timber, as belts of plantation, as coppice, as hop-poles, or as ornamental timber, according to local circumstances, and according to the nature of the land he may have to deal with. All of which modes of planting will be treated of in their proper places, and under their respective heads.

SECTION VI.—THE VALUE OF WOOD AS A CROP UPON LAND.

77. The value of wood, as a crop upon any given piece of ground, depends much upon the treatment it may have received in its cultivation. Trees, like every other useful product of the soil, may be considerably deteriorated in value by unskilful and careless management; and they may also be greatly enhanced in value by skilful and careful management. Besides, the value of wood varies according to the nature of the land planted, and also according as the locality may or may not be conveniently situated as regards a ready market for the sale of timber.

78. A plantation of trees, of whatever species it may be composed, is always of more value to the grower when in the neighbourhood of a thriving seaport, than the same plantation would be in a far inland district. The reason of this is obvious; for in the neighbourhood of a ready market for timber, the distance for cartage is not necessarily much calculated upon by the purchaser, consequently, he is enabled to give a fair price to the seller. For example, were I to purchase good ash timber from a proprietor whose plantations were within two miles of a shipping port, I would be enabled, upon consideration of the short distance, to give him 2s. per cubic foot: in this case, I would calculate upon selling the same wood at 2s. 6d. per foot, allowing the 6d. which I would receive extra for the covering of all necessary expenses and my own profit. Again, were I to buy the same quality of ash timber from a proprietor whose plantations were thirty miles from a shipping port, I could not give in this instance more than 1s. 3d. per cubic foot, because I would have to calculate that, although I got 2s. 6d. for this wood, it would take 1s. 3d. per foot to cover my expense of conveying the timber to the market, and at the same time to have a little profit for my own labour. And thus it is in all cases, that, for every mile of distance from the market, the purchaser of wood is obliged to give less to the seller; and this because he has to meet the extra expenses incurred in each mile of cartage, previous to getting it brought to market.

79. However, I may here state as a general rule, which I have verified from my own experience, both in England and Scotland, that land under wood will, at the end of sixty years, under good management, pay the proprietor nearly three times the sum of money that he would have received from any other crop upon the same piece of ground.

80. This assertion, I am aware, will be considered extravagant by many proprietors; but to those who may consider what I have here said as beyond the truth, I beg to say, that although it may be in reality beyond what they have themselves experienced as to profits arising from their plantations, yet I must say, that in all cases where good management has been introduced, what I have said will be found a practical truth; and in order to illustrate the point, I shall here give a few examples, exactly in detail as I have them in my note-book, of the different transactions as they took place under my own experience in the felling of wood upon various estates.

81. Upon the estate of Craigston, in Aberdeenshire, where the plantations are for the most part of larch, Scots and spruce fir, I have thinned them at all stages, from that of sixteen years old up to that of sixty, when they were cut down as ripe. And having taken a valuation of the trees, as taken from an imperial acre of plantation ground, at the different stages when thinning was required among the different plantations between sixteen

and sixty years, I make the average value of wood as a crop, upon an imperial acre of land in the district of country mentioned, as undernoted:—

At first thinning, which was at 14 years old, I took from one acre of mixed firs 600 trees, at ½d. each,		£1 5 0	
Deduct expenses of cutting the same,		0 5 0	£1 0 0
At second stage, which was at 20 years old, I took from an acre of mixed firs 800 trees, at 2d. each,		6 13 4	
Deduct expenses of cutting the same, and also that of keeping good the plantation, &c.,		2 0 0	4 13 4
At third stage, which was at 28 years old, I took from an acre of mixed firs 500 trees ,at 8d. each,		16 13 4	
Deduct expenses, as above,		4 10 0	12 3 4
At fourth stage, which was at 35 years old, I took from an acre of mixed firs 300 trees, at 1s. 6d.,		22 10 0	
Deduct expenses, as above,		6 0 0	16 10 0
At fifth stage, which was at 45 years old, I took from an acre of mixed firs 200 at 3s.,		30 0 0	
Deduct expenses, as above, and of sales, &c.,		8 10 0	21 10 0
At final cutting, when about 60 years old, I have taken from an acre of Scots firs and Spruce 180 trees, at 12s. 6d. each,		112 10 0	
Deduct from this expenses of sales,	£12 10 0		
— original expenses of planting,	3 0 0		
— expenses of trenching an acre of ground, and making the land good as at first,	8 0 0	23 10 0	89 0 0
Net produce of an acre of woodland in 61 years,			£144 16 8

82. In making the above statement of the value of fir plantations, as I had experience of them in Aberdeenshire, it is but fair to say, that the woodlands upon the estate mentioned had been very badly managed—consequently, their value was under many others in the same county. They had not been attended to in the way of properly thinning them in due time, which neglect had very much lessened the value of the whole per acre. I could point out many other estates in the same part of the country, the woods of which, from better management, were worth one-half more per acre at the different stages as compared with those stated above. But as I speak of these from observation only, and not from actual experience, I merely wish to observe, as to this matter, that instead of exaggerating the value of woodlands in the north, I have given a low statement.

83. Upon the estate of Craigston, there were generally planted upon the

acre four thousand trees. Now, from looking over the above statement as to the number of trees thinned from the acre at all the differents periods mentioned, from first to last, it will be seen that many of them had never come forward to any value—these, no doubt, having died from the want of attention. Thus we see that, instead of the number of trees which were planted, we can only account for two thousand five hundred and eighty; the remainder, about one thousand four hundred, having failed in some way or other; and that, no doubt, resulted from the previous bad management which prevailed upon the place in the growing of woods.

84. The annual rent of the land, at an average, upon which those plantations grew, was reckoned at about 10s. per acre; and had it been occupied by a tenant for the purpose of grazing, the proprietor would have received only £30 for an acre during the period of sixty years; but being occupied by trees, we see that he received by the end of the period of sixty years, when the crop was cleared off, no less than 48s. for each year of the period —and this, too, after deducting every necessary expense which the proprietor was put to. And even after deducting compound interest upon the original outlay and rent, progressively, during the periods when no return was received, it will be found, as I have formerly stated, that such land, when planted with trees, will pay fully three times the amount of money that it could do in the hands of a farmer; and this points out that wood, as a crop, even when very indifferently managed, is exceedingly profitable to the proprietor, and adds greatly to the value of his estate.

85. Next, in the county of Mid-Lothian generally, I have cut down and thinned woods to a great extent upon a number of landed properties: these consisted of mixed hard-wood plantations, oak plantations, larch plantations, as also Scots and spruce fir plantations. Upon these estates, I have thinned the various kinds of plantations, at all stages, from eight years up to seventy, eighty, and even one hundred years. And in order to point out clearly and intelligently the value which I have found derived from the different sorts of timber, at a given age, I shall give a statement of the thinnings which I have taken from an acre of wood, of each of the kinds above mentioned; and in doing this, I beg here to be understood, that, in the greater number of the plantations of each of the kinds I have taken my data from, they were not in good state, having been much neglected before I had occasion to visit them: consequently, I must say that their value, in most cases, might have been about one-third more had they been well attended to; but my object in the mean time is to give their value as I found them.

86. The following statement shows the medium value of a mixed hard-wood plantation, with firs to act as nurses, and is taken from the thinnings

of plantations which I have made upon eleven different estates in Mid-Lothian :—

At the first thinning, which was at an average of 10 years from the time of planting, I have taken generally 700 larches, at 1½d.,		£4 7 6	
Deduct from this expenses of cutting, &c.,		0 10 0	£3 17 6
At second thinning, being on an average when the trees were 16 years old, I have taken 600 larch and Scots firs, at 3d. each,		7 10 0	
Deduct expenses as above,		1 8 0	6 2 0
At third thinning, when the trees were 20 years old, I have taken 700 larch and Scots firs, averaging 6d. each,		17 10 0	
Deduct expenses,		2 15 0	14 15 0
At fourth thinning, when 25 years old, I have on an average taken 600 firs, at 1s. each,		30 0 0	
Deduct expenses for keeping up the fences, cutting, &c.,		3 10 0	26 10 0
At fifth thinning, when 30 years old, I have taken 80 firs at 2s. 6d.,		10 0 0	
Deduct expenses for pruning, &c.,		3 0 0	7 0 0
At sixth thinning, when 35 years old, I have taken 110 hard-wood trees of various sorts, averaging 8s. each,		44 0 0	
Deduct expenses,		6 18 0	37 2 0
At seventh thinning, when 40 years old, I have taken 100 hard-wood trees, at 15s.,		75 0 0	
Deduct expenses,		9 5 0	65 15 0
At eighth thinning, when 50 years old, I have taken 100 trees, at 30s. each,		150 0 0	
Deduct expenses,		10 6 0	139 14 0
At ninth thinning, when the trees were about 60 years old, I have taken 30 hard-wood trees, at 40s.,		60 0 0	
Deduct expenses of sale, &c.,		6 0 0	54 0 0
At final cutting, when the trees were about 70 years old, I have cut from an acre of land 50 hard-wood trees, at 60s. each,		150 0 0	
Deduct from this expenses of sale, &c.,	£15 0 0		
— original expenses of planting and enclosing,	5 0 0		
— expenses necessary for trenching an acre of woodland for agriculture,	15 0 0		
		35 0 0	
			115 0 0
Net produce of an acre of mixed hard wood, in 70 years,			£469 15 6

87. The average rent of the land from which I have taken the trees, as

above mentioned, may be about 30s. per acre; and if we divide £469, the value of wood, as taken from an acre in 70 years, by seventy, the number of years, we have £6, 14s. as the yearly rent for that time, instead of £1, 10s.; and this, too, after deducting every necessary expense which could be incurred by the proprietor. And even if we deduct compound interest progressively, it will be found that the proprietor has fully three times the income from a crop of wood that he could have received had the land on which it grew been in the hands of a farmer.

88. The following statement shows the medium value of an acre of oak plantation at the end of one hundred years, with firs to act as nurses, as I have found them in Mid-Lothian:—

At 8 years, being first thinning, 800 larches, at 1½.,	£5	0	0			
Deduct expenses of cutting, pruning, &c.,	1	5	0			
				£3	15	0
At 12 years, being second thinning, 500 larch and Scotch firs, at 2½d.,	5	4	2			
Deduct expenses of cutting, pruning, &c.,	1	15	0			
				3	9	2
At 18 years, being third thinning, 900 mixed firs, at 4d.,	15	0	0			
Deduct expenses of cutting and pruning, and of keeping good the fences, &c.,	3	5	0			
				11	15	0
At 23 years, being fourth thinning, 200 firs, at 1s.,	10	0	0			
Deduct expenses, as above,	2	0	0			
				8	0	0
At 27 years, being fifth thinning, 100 firs, at 2s.,	10	0	0			
Deduct expenses, as above,	1	10	0			
				8	10	0
At 31 years, being sixth thinning, 100 firs, at 3s.,	15	0	0			
Deduct expenses, as above,	2	5	0			
				12	15	0
At 32 years, being seventh thinning, 150 oaks, at 5s.,	37	10	0			
Deduct expenses of peeling, cutting, &c.,	6	5	0			
				31	5	0
At 36 years, being eighth thinning, 40 oaks, at 10s.,	20	0	0			
Deduct expenses, as above,	2	10	0			
				17	10	0
At 40 years, being ninth thinning, 50 oaks, at 15s.,	37	10	0			
Deduct expenses, as above,	4	0	0			
				33	10	0
At 45 years, being tenth thinning, 30 oaks at 25s.,	37	10	0			
Deduct expenses, as above,	3	10	0			
				34	0	0
At 50 years, being eleventh thinning, 25 oaks, at 35s.,	43	15	0			
Deduct expenses of sale, &c.,	5	15	0			
				38	0	0
Carry forward,				£202	9	2

Brought forward,			£202 9 2
At 60 years, being twelfth thinning, 20 oaks, at 50s.,		£50 0 0	
Deduct expenses, as above,		4 10 0	45 10 0
At 70 years, being thirteenth thinning, 15 oaks, at 80s.,		60 0 0	
Deduct expenses of sale, &c.,		6 10 0	53 10 0
At 100 years, being final cutting, 35 oaks, at 140s.,		245 0 0	
Deduct expenses of sale,	£24 0 0		
— original outlay in planting per acre,	5 10 0		
— expenses of trenching the land and the crops,	15 0 0	44 10 0	201 10 0
Net produce of an acre of land in 100 years, as found under oak wood,			£502 19 2

89. From this statement it will be seen that the oak plantation, at the end of one hundred years, pays the proprietor £5 an acre per annum; whereas the mixed hard-wood plantation pays nearly £7 an acre at the end of seventy years; and this is actually the case, as I have the result from my own experience. I have indeed, in several instances, found the oak much higher per acre than here stated; and I have also found it much lower: my object here has been to give the medium in both cases; and, generally speaking, a mixed hard-wood plantation will be found more profitable than oak alone; and the reason I have found to be this—plantations are generally badly managed, and oak trees suffer from bad management more than most other trees. Oaks, when much confined in their young state, soon become tall and slender, and will not readily recover themselves again—at least as compared with ash, elm, or sycamore, &c.; consequently it is generally from bad management that the oak is found under the value of mixed hard-wood per acre. But in most cases, where the soil is well adapted for the growth of the oak, and where attention has been properly bestowed upon it, it will be of considerably more value from eighty to one hundred years than any other tree—all depending upon the nature of the soil and the management.

90. The following is a statement of the value of an acre of larch plantation, upon favourable soil in Mid-Lothian, at the end of sixty years, when it may be considered at its highest value:—

At 10 years, thinned out 500 trees, at 1d. each,	£2 1 8	
Deduct expenses,	1 0 0	£1 1 8
At 15 years, thinned out 500 trees, at 2½d.,	5 4 2	
Deduct expenses,	1 8 6	3 15 8
Carry forward,		£4 17 4

Brought forward,			£4 17 4
At 20 years, thinned out 600 trees, at 8d.,		£20 0 0	
Deduct expenses,		2 10 0	
			17 10 0
At 25 years, thinned out 300 trees, at 1s.,		15 0 0	
Deduct expenses,		3 0 0	
			12 0 0
At 30 years, thinned out 200 trees, at 3s.,		30 0 0	
Deduct expenses,		3 15 0	
			26 5 0
At 35 years, thinned out 150 trees, at 5s.,		37 10 0	
Deduct expenses,		4 5 0	
			33 5 0
At 40 years, thinned out 100 trees, at 10s.,		50 0 0	
Deduct expenses,		5 10 0	
			44 10 0
At 45 years, thinned out 100 trees, at 20s.,		100 0 0	
Deduct expenses,		10 0 0	
			90 0 0
At 50 years, thinned out 50 trees, at 30s.,		75 0 0	
Deduct expenses,		7 10 0	
			67 10 0
At 60 years, or final cutting, 100 trees, at 50s.,		250 0 0	
Deduct expenses of sales, &c.,	£25 0 0		
— original expense of planting,	3 0 0		
— expense of trenching the land,	8 0 0		
		36 0 0	
			214 0 0
Net value yielded by an acre of larch in 60 years,			£509 17 4

91. From this statement of the value of an acre of larch plantation, it will be seen that at the end of sixty years, under favourable circumstances, the proprietor will receive £8, 10s. as the rent of his land per acre; and so it is. Larch, when it thrives well, pays better than any other crop of wood in a given time. Nearly two crops of larch could be had off land by the time that the oak had arrived at its maturity, as the larch will generally be found at its full value at or about sixty years.

92. The Scots pine and spruce fir take much longer in coming to maturity than the larch does; the Scots pine in particular cannot be said to have arrived at maturity under eighty years; and upon the same principle of calculation as already shown in the three statements given, the average value of an acre of Scots pine, at the end of eighty years, may be taken at about £300, and spruce fir at about £260. The reason of the inferiority of the value of these is, that the Scots pine is not so much sought after in its young state as the larch is; neither is the spruce fir; both being much inferior in the value of their wood till of full age; and even then the larch sells at one-fourth more than either of them.

93. What I have said above refers to the value of a crop of wood when trained up as timber trees. There are, however, many proprietors, both in England and the west of Scotland, who cultivate their wood-lands upon the principle of coppice-woods, without allowing almost any of the plants to become timber of useful size. This system of rearing what may be termed general coppice-woods is indeed very profitable near large manufacturing towns, such as Liverpool and Manchester; for near such markets young growths of almost all sorts of hardwood meet a ready sale, and at high rates, for crates, baskets, and other wicker-work; and as this method of cultivating woodlands is attended with very little trouble, and requires very little practical knowledge in the grower, it is much resorted to in many parts of England, even where the cultivation of large timber would ultimately pay the proprietor three or four times the amount he receives for his crops of coppice-wood. Now this is certainly an error much to be regretted, and which ought to be exposed; and in order to this, I beg to make a few remarks, that proprietors possessing such coppice-woods may be able to judge for themselves whether their woodlands, so managed, pay them or not.

94. I select the following example in illustration of the point. In 1848 the Earl of B——— requested me to visit his woodlands upon his estate at H——, in Lancashire, which I did; and upon looking over them, I found them to consist mostly of oak, ash, hazel, and mountain-ash coppice, with only a very few young timber plantations, which had by no means been well managed, having been much neglected, both as regards thinning and pruning. His lordship, being a most active-minded and improving nobleman, saw that the system of management which had hitherto been pursued among his woodlands was not as it ought to be; many of his coppice-woods had been cut, from time immemorial, at periods of about fifteen years, and were now becoming worthless from age; and he wished to introduce a new system of management in this department, which he would have done at an earlier period, but was dissuaded from doing so by many who maintained that his estate of H—— was not adapted for the growth of heavy timber. Upon examining the nature of the soil and situation upon the estate, I was thoroughly convinced that few estates in the north of England were better adapted for the growth of heavy oak timber, and I advised his lordship accordingly. Now here is an estate, the woodlands of which, as now found under mixed coppice, and cut down at periods of fifteen years, have paid the proprietor no more than twenty shillings per annum of rent. These woodlands have indeed served to supply the market with cheap hoops and bobbin-wood, but it is a profitless speculation to the proprietor; for had

the same land been planted with oaks and a mixture of larch and Scots firs, the proprietor would, instead of twenty shillings per annum per acre, have received at least £5 per annum: and if his lordship proceed as I have advised him in this matter—that is, to do away with the coppice-wood gradually, and replant with oaks for a permanent crop, and make up with larch and Scots firs for nurses—he will ere long not only receive five times the present amount of rent for his woodlands, but will also beautify his estate in a tenfold degree. And, besides this, he will at the same time be setting an example of improvement to his neighbour proprietors, who appear to be against the doing away with the old system, however profitless it may be. There are very many landed proprietors, both in England and Scotland, situated in the same manner. They have a great extent of woodlands, growing coppice of the description I have described—for the produce of which they receive a ready market, but at a very low price: therefore it is that they are not inclined to enter deeply into the improvement of their plantations, thinking that it is not a profitable business to grow wood, not having experienced a better system of management, and seeing they can seldom realise more than thirty shillings per acre for its produce; whereas, were such proprietors to replant, as I have said above, they would eventually derive about five times the income from their land that they now do by their present system of management under coppice.

95. As I have already said, if the proprietor can sell his coppice at a fair price—which can generally be done in the neighbourhood of a market for such wood—it is proper and right that he should do so, in order to supply his neighbourhood with the sort of wood most in use; but where a proprietor cannot get for his wood crop at least three times as much money as he could from the same land were it under agricultural crops, he has a right to say that there is something wrong in his district as regards the value of his woods. No proprietor of woods is called to grow any sort of wood-produce for his neighbours, and sell it to them at a cheap rate, while he can, by altering his system of wood management, sell his produce to a greater advantage at some other place, and in another form.

96. From what has been stated above, it will be seen that, in order to make wood come out as a valuable crop upon any piece of land, much depends upon the management of the parties who have the superintendence of it; and this not only as regards the training up of the crop, but also in the choice of the kinds of wood planted, whether these are adapted to the wants of the wood-market in the neighbourhood. For example, in the county of Aberdeen, where all sorts of hard-wood are scarce, I have sold ash for 4s. a foot; while in the Lothians, where ash-wood is plenty, I

could not get more than 2s. a foot for the same quality of wood: therefore, in the northern counties of Scotland, the proprietors who pay attention to the growing of ash-wood will find a high price for it; while, upon the other hand, pine, which is very plenty in the same parts, sells at a very low rate.

97. Again, in the southern parts of the island, where hard-wood is plenty, it is bought at a moderate rate; while good pine, which is comparatively scarce as compared with the north, is generally sold at a good price.

98. These examples I consider quite sufficient for the present purpose. I might, indeed, from my more extended experience on the subject since these remarks were written, give many others in illustration of the point under notice, but as they would only go to swell this work without altering the facts as stated, I think it preferable not to do so. But I may add that it is not alone the simple value of the timber that makes plantations of so important a nature upon a gentleman's property: there is the shelter that they afford to all agricultural purposes; for where no plantations exist, there is invariably an inferior crop of grain upon the fields, as well as an ill-fed live-stock, which should all be taken into account. I am, indeed, of opinion that, upon any landed property, well-managed plantations are incalculably of more value than land three times their extent in the hands of a farmer, but without trees to give shelter; and it is well known by every proprietor of land that he receives by far the highest rent for those parts of his lands which are most sheltered by his best plantations. And further, of whatever value land may be in the hands of a farmer without plantations to give shelter to it, it is of very much greater value when properly sheltered by them.

SECTION VII.—THE CONDITION OF FORESTS AND PLANTATIONS AS GENERALLY EXISTING IN GREAT BRITAIN.

99. It is a singular fact in the history of the rural economy of this country that no branch of it has been hitherto so much neglected as that of forestry. The art of gardening, as well as that of farming, has received all the attention that science, skill, and wealth could bestow upon it; while forestry has been comparatively neglected, so that few improvements have been effected in the growth of trees beyond what our fathers put into practice; if we may except that we know better how to apply drainage and thinning to their welfare than they did.

100. This state of things in regard to forestry is, I think, to be accounted for, partly from the want of a properly qualified class of men having been

put in charge of woodland property, partly from the very small returns which, in most cases, have resulted to proprietors from their woodlands, whereby they have been deterred from entering into this department with spirit; partly from the nature of the crop requiring a considerable number of years to bring it into paying condition; and partly from the subject not having been taken up sufficiently by scientific men, who alone can really assist the practical forester in the carrying out of improvements in his profession.

101. For many years past we have had periodicals almost entirely devoted to the subjects of horticulture and agriculture, in which both science and practice have been brought to bear with powerful effect upon them, and from this every gardener and farmer has derived the highest advantage, and has been enabled to work wonderful improvements, each in his own department; while an article bearing on the cultivation and management of trees has but rarely appeared for the instruction of the forester: and to this fact, I have no hesitation in asserting, is mainly to be attributed our want of a better state of forestry than we have at the present day. It is, then, hardly to be wondered at, that our forests are far from being in a satisfactory state; that but few improvements have as yet been effected in their management as compared with the other branches of rural economy; and that therefore much has yet to be done by all parties engaged in rearing them before they can be put into a really prosperous and satisfactory condition. The question then is, What are these particulars, as regards our forests and plantations, which mark them as generally in an unsatisfactory condition? As the question is one of very great importance, not only to landed proprietors individually, but in a national point of view, I shall endeavour to do the answer the justice it is entitled to, and that as briefly as the subject will admit of.

102. During the last ten years I have examined professionally the woodlands upon estates in nearly all parts of the country, from the south of England to the north of Scotland, and I have thus been enabled to inspect minutely a large extent of plantations, spread over a great diversity of soil and climate, embracing all the sorts of trees grown as timber in this country, and under every sort of management. I hope, therefore, to be able to take up the subject under notice in such a way as to make my remarks upon it serviceable to all parties having an interest in our national forests, as well as in the private forests and plantations of proprietors generally.

103. The forests and plantations of this country may properly be divided into two classes—namely, PUBLIC and PRIVATE. By the former I mean those belonging to our government, the principal of which are the New Forest, in Hampshire; Dean Forest, in Gloucestershire; Delamere Forest,

in the county of Chester; and the forests of Bere, Alice Holt, and Woolmer, in Hampshire, in which the professed object is that of rearing oak timber for the supply of our dockyards. By the latter, I mean those belonging to our landed proprietors generally, in which the crops are reared with the view of their being made available either as ornamental to the estate, or as sources of private income to their holders. With regard to the former, as they are public property, I shall refer to their condition individually and particularly; but with regard to the latter class, I shall refer to them only collectively, as we have no right to interfere with the management of any private proprietor, but only to refer to the condition of his property in a general way.

104. I shall now make a few statements with regard to the condition of the New Forest as it was when I visited it in 1853. At that time the land actually under a crop of planted trees extended to nearly 10,000 acres. This crop was at the date referred to of various ages, from 150 years down to a few years, and was spread in detached portions, as separate plantations, over the district of country called The New Forest, and which embraces altogether somewhere about 66,000 acres.

105. The older class of the woods of this forest, at the time I refer to, extended to 2460 acres, embracing 17 inclosures, and was planted between the years 1700 and 1775. The trees of it consisted of oak chiefly, with a partial intermixture of beech, and the soil upon which it stood, and on which part of it still stands, is for the greater part either a clay loam or sandy loam, with occasional rising knolls of gravelly soil; and the greater extent of it was then wet, and did not appear ever to have been drained.

106. I found the timber of these older plantations of a tall and drawn up character, evidently from its never having been attended to, nor thinned in a judicious way. In consequence of this neglect, and from the natural wetness of the soil, I found a large proportion of it inferior both in size and quality, and also a considerable portion in a state of decay. Besides these causes of the inferiority of the crop in the older woods of this forest, I found that a system of felling large quantities of the best of the timber from time to time, in all parts indiscriminately and without reserve, had been adopted, whereby the trees left had become generally unhealthy, and were for the most part becoming shaky in their timber, and fast deteriorating in value.

107. Such, then, was the condition of the older class of plantations in the New Forest in 1853, when I visited it. I understand, however, that since then very considerable improvements have been effected here from the regular and systematic clearance of these old woods, and from draining and replanting the land on which they stood.

108. Another class of plantations of this forest had been planted between the years 1808 and 1846, and this extends in all to 7029 acres, distributed over the forest lands in 52 distinct plantations or enclosures, the crop in them all being oak chiefly, with fir nurses in the younger ones. In describing the condition of this class as I found it in 1853, I think that I cannot do better than give the exact remarks made on the spot as I have them in my own note-book, and which are as follows:—

109. "In looking over the plantations in this forest which have been made since 1808, it is at once evident, from the generally drawn up character of the oak trees which now constitute the great body of the crop, that till within the last four or five years they had been left in an extremely confined state among their nurses, and that their healthy and full development has been greatly arrested in consequence. The nurses which had been planted in these plantations were Scots pines, a tree in all cases objectionable as a protection for the rearing of oak; these have now, however, for the greater part, been removed; but this has generally been done too suddenly, and not in such a gradual way as was necessary in order to secure the health of the oaks, after these had stood so long in a confined state; and the result now is, that these have generally suffered very much in health from the effects of too sudden exposure after the pine nurses were removed.

110. "These remarks as to the condition of the crop in the plantations of the New Forest are, however, only applicable in a general sense, or rather this injury has only to a certain extent ensued; for in most of these enclosures there is a portion of the crop comparatively good at the respective ages of the trees, which will, under future good management, become first-rate timber. This is the case where the soil is of a good and comparatively dry character, on which the oaks have, at an early state of their growth, got the ascendancy over their pine nurses, and consequently have not been so much injured by them as others have been on the wetter and poorer portions of the land, where the oaks have grown comparatively slowly, and have been very much injured by the pines, which on such land grow more rapidly.

111. "In addition to the neglect of timely thinning, drainage has also been neglected in the past management of these plantations. This, indeed, forms the chief cause of the comparative inferiority of the crop on the greater portion of the land which has been enclosed and planted since 1808; for had the important work of drainage been attended to, at least wherever wetness appeared, the trees in these enclosures would have been generally more healthy and valuable than they now are, even under the unfavourable circumstances of close confinement in which they have generally existed."

112. The foregoing remarks are applicable to the condition of the plantations only, and do not apply to the crop of natural trees spread over a large portion of the forest land (perhaps over 8000 acres), and which consists of very old oak and beech.

113. I learn that since my visit to this forest very great improvements have been made in the condition of the young plantations referred to, and that the parties in charge have taken my advice, and acted upon it, in regard to drainage, systematic thinning, &c. &c.

114. In the forest of Dean, together with the district called Highmeadow Woods, both in the county of Gloucester, the land under trees that have been planted extended in 1854 to nearly 17,000 acres. This crop is chiefly oak, of various ages, from the matured tree down to that only a few years planted, while in the most recently made enclosures the nurses were larch and Scots pine.

115. When I examined this district of the government woods in 1854, I found that a pretty large proportion of the comparatively young plantations had been much over-thinned, and, consequently, that the trees on such parts had become of a rough and branchy character, while another pretty large proportion was excessively crowded, and did not seem to have been attended to in the way of thinning for a considerable number of years. On a considerable extent, however, I found the young crop of this forest in a fair condition; but it was evident that no well-devised system of thinning had been adopted, as the trees exhibited all sorts of conditions, from that of extremely crowded to that of thin and far apart. The result of this irregularity was great diversity in the character of the trees: in some places they were of a rough and branchy character; in others thriving and well balanced; and in others drawn up and weakly.

116. On the unenclosed parts of this forest I found a pretty large quantity of good old oak timber; on some parts it was crowded, tall, and drawn up to great lengths, while in other parts it stood far apart, tree from tree, was of a rough and branchy character, and generally short of stem. This, I believe, has been for the most part recently cut down, and the ground which it occupied replanted.

117. Previous to my visit to this forest, little or no attention had been paid to drainage, so that when I examined it I found large portions of the planted enclosures in a very wet condition, and the trees on them in a weakly state in consequence. Recently, however, considerable attention has been paid to the drainage of the wet parts of the land under trees, as well as to systematic thinning,

118. In Highmeadow Woods the greater bulk of the crop is oak coppice timber trees, generally matured in growth, and of this description of crop

there are 2313 acres. The following extracts from my notes on the spot will show the character and state of the crop :—

119. "The larger number of the trees on this extent (the 2313 acres referred to in last paragraph), having been reared from coppice shoots, are not only inferior in point of size at their age, but, in my opinion, will never improve to such a degree as to become valuable timber of large dimensions, nor even to such an extent as to justify their being continued as a profitable crop on the land they occupy. Over the whole extent, the trees, even within the compass of a few acres, vary much both in size and age. On some parts the crop appears to have attained fully 100 years, on others not more than 50, and on a very considerable extent it appears to be a general mixture of trees of all ages between 30 and 100 years, while over the whole of the ground there is growing under the trees a dense mass of underwood, the presence of which has had a great tendency to deteriorate the value of the oaks, which, from the cause stated, are generally in a drawn up, weakly, and neglected state." Such was the general condition of the crop in the forest of Dean and in Highmeadow Woods when I last visited them.

120. I shall next give a short account of the state in which I found the forest of Delamere, in the county of Chester, at the time I visited it in 1853. This forest extends in all to 4023 acres nearly. It is divided into seven separate enclosures, and has been planted with oak, chestnut, larch, and Scots pine. I found about 1776 acres of it, consisting of good dry loamy land, with a crop of oak, chestnut, and larch, upwards of 30 years of age. Generally speaking, I found this extent of crop in a crowded condition, and that no regular system of thinning had been adopted for its welfare. Other portions of good dry land, extending in all to about 700 acres, were under a crop of Scots pine and larch, at wide distances apart, and about 30 years old, intermixed with oak and chestnut plants under 20 years of age. These portions of crop were then in a very unsatisfactory condition, as the shade of the pine and larch prevented the healthy growth of the hardwoods, which had become branchy and of a rough habit of growth—from standing comparatively far apart, and from the shade of the older trees among them. Another portion of 700 acres consisted of a thin moorish description of land, under a crop of the same description as the last referred to ; but, from the poor nature of the land, it was not capable of growing the hardwooded trees that had been planted upon it. I found also 744 acres under a crop of Scots pine, partly in an excessively crowded state, and partly with its crop thinly distributed over the ground.

121. The crops in the forests of Bere, Alice Holt, and Woolmer, all of

which are comparatively small, consisted of partly oak, partly Scots pine, and partly larch—chiefly young—of various ages and intermixtures, and in very much the same condition as those in the forests already described. Having made these statements in regard to the condition of the crops in the forests named, I shall now proceed to speak of the general management under which they have existed.

122. From what I have stated in regard to the crop in the government forests of this country, it may be inferred that no well-defined system of management had been, up to the time I visited them, put into operation for the welfare of the trees constituting them; and hence the trees of the various ages in the plantations were partly thinly distributed, and therefore of a rough and branchy character, partly in a fair condition in regard to the distance apart, partly in an excessively crowded state, and therefore drawn up and weakly of the age, and partly of sorts planted on soil quite unsuitable for their healthy growth to large and profitable dimensions. It cannot be disputed, therefore, that previous to the year 1853 the crop of these forests had not been dealt with in such a way as to secure and induce the greatest possible development of the trees, and to ensure their ultimately arriving at such dimensions as timber, as the soil, generally speaking, is capable of bringing them to.

123. This state of things, then, is very much to be regretted in regard to the forests of a government such as that of this country, whose strength lies in the maintenance of a well-conditioned navy. The growth of trees in these forests was avowedly undertaken for the purpose of rearing a supply of British oak for the maintenance of the navy. It is singular, therefore, that the parties in charge did not go about the business of planting and rearing upon a better principle than they did, and that they should have allowed these to be dealt with in the unsatisfactory way they have, especially after such an expenditure of the public money as must have been made in the different works of fencing, planting, and general maintenance.

124. When, however, it is understood that the parties placed in charge of these forests were not men who had been trained to the business of tree culture, the singularity of the result is at once removed. It is scarcely necessary to say, that any one put in charge of any branch of business with which he is practically unacquainted, is sure to fail in carrying it out to satisfactory results. The primary cause, then, of such a condition of the crop in these forests as has been described, is the want of proper knowledge in the parties who had or have the management of it.

125. The results of the want of proper management on such a crop as that in these forests must be a vast loss of money to the country, independent of the rearing in them of only a second-rate quality of timber, and this

point is worthy of the serious consideration of all parties concerned in the rearing of our national forests. Let me therefore briefly refer to it.

126. It must be set down as an undoubted fact, that trees that have been stunted from injudicious management while young never can afterwards, under any system, however good, arrive at the same size and value they would have done had they been properly dealt with from the first. This is a fact too well known to be disputed by any practical and qualified person. It is then certain that a very large portion of the crop in the government forests cannot now arrive at such value as it would have done had a better system of management been put in operation at an early stage of its growth. I shall illustrate my meaning still farther.

127. Suppose that there are 40,000 acres of land in these forests capable of bringing a crop of oak to maturity, and to large dimensions, and supposing that the ultimate value of such a crop, if well managed, would be, on the average, £600 per acre—which is not too high—the entire value of it to the country would thus be *twenty-four millions*, and this independently of the produce of thinnings, which fall to be taken into account, but which I shall allow to go for income from the land while the crop grows upon it, and for maintenance and management. On this principle, then, it is clear that the country would be highly benefited by these forests. On the other hand, if they shall continue to be managed as they seemed to have been up to 1853, the result will inevitably be a comparative failure to a large extent, and their ultimate value will not exceed *ten millions;* while their timber to a large proportion will be unfit for the purposes of the navy dockyards.

128. Such considerations as these should surely call forth the energies of the Commissioners of our national Woods and Forests, and cause them to appoint none to their management but such men as are well experienced, and qualified for the rearing of timber on the soundest known principles of forestry.

129. With regard to the woods and plantations of private proprietors of this country, both in England and Scotland, I cannot say that their condition, generally speaking, is better than that which has been described in regard to our government forests. I have examined, professionally and non-professionally, a large extent of woods and plantations on private properties in all parts of the country; and, with a few exceptions, I have found them in an unsatisfactory condition, both in regard to drainage and thinning. I say with a few exceptions, as I could point out several estates on which the woods have been well managed, and this simply because such have happened to be under the direction of men who understood the business of forestry, as far as that is known at the present time.

130. On examining the older class of plantations upon private proper-

ties, I have found that a very large extent of them consists of trees that have been planted on land not suited to the crops respectively—that drainage had been all but neglected previous to planting where the land was wet—that thinning had been generally ill understood and injudiciously applied—that, to a large extent, the better trees of the crops had been taken in the act of thinning, and the weaker ones left on the land—and that a large area of them had been left entirely unthinned—until the trees had become so drawn up and weakly, that they could not be afterwards recovered to anything like a valuable crop by any system of management. This description is generally applicable to the condition of a large extent of the older plantations on private properties; but in speaking of the younger class—say under 30 years' standing—I am glad to say that I have found them for the most part in a better managed and more hopeful condition. I have, it is true, found in my surveys a considerable extent of young plantations which had been unthinned until I saw them, although upwards of 20 years of age; but this is the exception, and not the general rule in reference to these plantations. With the exception, however, of a few estates, as already hinted, the woods on most properties are far from being managed in such a way as to insure the crops arriving at anything like the value the land is capable of bringing them to. In short, there seems to be a want of system in the management of plantations on the greater number of properties; and from this circumstance, I have found the crops, generally speaking, partly drawn up from want of thinning, partly sickly from want of drainage, and from the soil not being suited to the crops, and the trees partly of a rough and branchy character from overthinning for sale, where they had previously grown well, and attained considerable dimensions at the respective ages.

SECTION VIII.—FORESTRY AS AT PRESENT UNDERSTOOD AND PRACTISED IN GREAT BRITAIN.

131. Forestry being an art still in its infancy, and one, from the nature of its crop, requiring a considerable number of years to test the results of any experiments that may be made in it, is not so readily defined in all its branches as farming is. The subject is a long and a broad one, requiring an age of observations and experience in any one to understand the effects of certain modes of operations on certain of its branches; and it is very much to this cause that the very slow progress that has been hitherto made in improving tree culture is to be attributed. It is no exaggeration to say that the art of forestry, as at present practised in this country, is not, excepting in a few points, very much different from that which was

practised by our fathers many years ago, and that years must yet elapse ere we can show evident proof that we have in all respects advanced in the right direction. This every sensible and experienced man will readily admit, as he is well aware that the results of cropping land with trees require at least fifty years to ascertain. Having thus premised, I shall give an abstract outline of the chief heads of forestry as at present practised on the greater portion of the wooded estates of this country: afterwards I shall add some comparative remarks on each of the branches.

132. Forestry, then, as at present generally practised, may be summed up under these *nine* heads: First, the rearing of the young trees in the nursery-ground previous to their being planted in their permanent sites; Second, fencing the lands to be planted, in order to separate them from the agricultural portions of the estate, and to prevent cattle from getting into the plantations; Third, drainage of wet portions of the land purposed to be planted; Fourth, the distribution and planting of the young trees intended as a crop; Fifth, pruning of such trees as seem of a branchy and rough habit of growth; Sixth, thinning for the promotion of the growth of the better portion of the respective crops; Seventh, the stripping of bark from such of the trees as have it suitable for tanning purposes; Eighth, the clearing of a matured crop of trees, and its disposal; and, Ninth, the manufacture of timber.

133. With regard to the mode of rearing young trees in the nursery-ground, great improvements have been effected within the last ten or fifteen years. Previous to the latter date, the mode was to sow the seeds of the different sorts of trees very thickly in the beds, so as to raise as many plants as possible from a small piece of ground, and to allow the young plants to stand two years in the seed-beds before their removal to the nursery lines. Now, however, the most intelligent tree-rearers agree that the young plants are much improved in health and strength by sowing thinly in the beds, and by removing them into the lines when one year old only. Besides this improvement, another has been effected by attention to a judicious system of rotation in cropping. This was not attended to by the older class of nurserymen, and the consequence was that their young plants became unhealthy from the same sorts being repeatedly grown on the same piece of ground, without any intervening crop.

134. As to fencing, the chief improvement that has been effected within my remembrance is that of the use of wire and iron straining-posts; and it is a very great improvement, inasmuch as it is not only more ornamental than any other description of fence, but also infinitely more valuable in its durability than the old mode of fencing with wood alone.

135. Drainage, in the proper sense of the term, and as applied to wood-

lands, may be said to be an improvement of our own day, as I can well remember when it was not only little applied, but, where it was so, it was done on such a shallow principle as to be quite inoperative. For drying wet parts of woodlands, simple cuts of some 12 inches deep were considered sufficient within my own remembrance. Now, however, experience has taught us all, that where the land is naturally wet, from 30 to 36 inches in depth is absolutely necessary. In this respect we are much in advance of our fathers, as, from the better application of drainage, we can now grow crops of good timber on land which they thought quite unfit for the purpose.

136. In the branch of distributing the young trees in a plantation, much experience has been gained within the last twenty years, and from this important experience we are now enabled to grow certain kinds of trees on certain descriptions of land, which formerly were considered unfit for planting, with any hope of success, with any sort of tree. The science of chemistry has given us much insight on this branch of forestry, as from it we can now understand the nature of the soil and its component parts; and from knowing somewhat of the food necessary for each sort of tree we plant, we can generally adapt the one to the other.

137. Pruning, generally speaking, was of all the branches of tree culture the least understood by the older class of foresters. Thirty years ago, the system practised was chiefly that of lopping off all large branches from the stems, without respect to age, size, or kind, leaving the subjects standing like so many May-poles. The science of vegetable physiology has, however, taught us differently, and we now prune very sparingly, well knowing that the removal of large branches from trees deprives them, according to the extent of the operation, of the organs with which nature has provided them for the digestion of the food they take in by their roots. In this branch of forestry, therefore, we have made important discoveries and improvements of late, and this from our better knowledge of the laws which regulate the healthy growth and development of trees.

138. Thinning plantations for the promotion of the growth of the best of the trees is a branch of forestry still but ill understood. This is proved from the generally crowded and unsatisfactory state in which we find most plantations in all parts of the country. The old mode of allowing trees in a plantation to stand so long unthinned as to become crowded, and thereby exhaust the soil, weaken their roots, and deprive their stems of branches, is still tolerated to a large extent, although nothing is more destructive to their healthy development.

139. This is certainly a singular fact in the history of the arboriculture of this country; more especially when we consider and take into account

the great improvements that have been attained in the other branches of rural economy. Notwithstanding the generally high intelligence of our landed proprietors, and that they are far-sighted enough in the improvement of the agricultural portions of their estates, it cannot be denied that they are generally short-sighted in respect to this branch of their estate management, although by a proper attention to it, and understanding of it, they might be gainers to an incalculable extent. This no doubt arises from the incapacity of those who have the management of their woods. With the exception of a few who are engaged in the profession of forestry, most men seem contented to allow the woods under their charge to grow up as if no rule could possibly be applied to the subject of thinning them; and consequently, for the most part, we find them without any definite ideas on it, and dealing with it as their predecessors did some fifty years ago. I am glad to say, however, that within the last twenty years a few superior men have appeared as foresters, and have adopted a system of thinning, on a regular and systematic principle, by which the crops are kept, at all stages of their growth, in a regular state, one tree from another, and from this at all times in an equally healthy condition, and are never allowed to become crowded before thinning, as is too often the case.

140. The stripping of the bark from oak and other sorts of trees for the purpose of tanning is an important branch of forestry in many parts of the country, and especially in those parts where oak is the chief woodland crop. On this branch little or no improvement has been effected within my remembrance, although there is reason to believe that a better mode of drying the material might be adopted than that at present in use—in the open air, and unprotected.

141. The clearing of a crop of matured trees, its disposal and manufacture, is now, from the use of machinery by steam power, a comparatively easy process compared with what it was previously, when only horse and manual power could be applied. I shall treat this subject at length in another part of the work; at present, I only refer to it for the purpose of stating that on these branches of forestry very considerable improvements have been effected of late.

SECTION IX.—THE CAPABILITIES OF FORESTERS, AS A BODY, TO CARRY OUT IMPROVEMENTS IN ARBORICULTURE.

142. We all know that a surgeon cannot practise successfully on the human subject unless he has been trained by a thorough acquaintance of the anatomy and constitution of man; we also know that a veterinarian cannot

practise with any hope of success on the diseases of the horse unless he has studied the anatomy of that animal; and we are also aware that every man who means to be an intelligent and profitable farmer must learn the art, not only practically, but also theoretically, in all its branches. If in such cases training to the end in view is so necessary to success, it follows that foresters should undergo a certain course of training before they can be safely and profitably intrusted with the rearing of plantations. Further, it is admitted as a general rule in all professions, that in this age of general improvement, whatever department a man shall take up as his particular business, he should, before entering into it, whether upon his own account or as agent for another, make himself acquainted with such branches of science as have a direct bearing on it, and are likely to qualify him for it, as, if he do not, he cannot possibly succeed creditably to himself or to his employer. Admitting these points—and their practical tendency cannot be disputed—it must be confessed that the general capabilities of most foresters of the present day do not tally with them. There are several of the sciences which have a direct bearing on the art of forestry; and without a knowledge of them it is all but impossible for a man to be an arboriculturist in the true sense of the term, or at least to such an extent as to enable him to carry out improvements in the art with profitable results; and from these considerations, the conclusion follows that of the men who are engaged in forestry, and have the management of woods, there are comparatively few who have received such a training and education as is necessary to their being trustworthy and intelligent in all respects in the line of their business. As this is a highly important point both to foresters and proprietors, and one in which I am personally deeply interested—in fact, one to which I have devoted a large part of my attention to explain and illustrate during the last twenty years—I shall here take it up, somewhat fully, for the benefit of all concerned, more especially as on the proper qualification of foresters depends much of the future success in the art of arboriculture.

143. I am acquainted with a large number of foresters occupying trusts in all parts of the country, and among them all I do not happen to know more than a dozen who may be said to be really qualified men, and capable of conducting their charge in an intelligent and really trustworthy manner. By far the greater number of them are mere workmen whose only qualification is, that they can plant trees in the usual way, and cut them down with the axe when local circumstances require the operation. Even in the government forests, in which we should expect to find men of first-rate qualifications, I found that they were as ignorant of the sciences that bear upon forestry as the most common forester I could name; and the result

of this want of knowledge is, that the crops under their charge have not succeeded so well as they would have done had they been under the inspection and control of men in every respect learned and trained for the charge. This may by many be considered an overdrawn picture of the state of matters under notice, but I am prepared to prove that it is by no means so, but represents the simple truth of the case in regard to the general capabilities of the men who have the management of plantations in this country. But proprietors are themselves partly to blame for this state of things in regard to the general incapacity of foresters.

144. It would indeed seem inconsistent in the manager of an institution to appoint a man who had no skill in medicine and surgery to act as doctor to the patients of the institution; and yet this would only be a parallel case to many which I could name, as practised by landed proprietors in their appointment of men to the management of their woodlands. Generally speaking, they seem to look upon trees as things that can take care of themselves, and that require no particular attention after they are put into the ground. Than this view of the matter, however, there can be nothing more erroneous, as, without skilful attention in many respects, trees can, after they are planted in a mass, no more grow up profitably as a crop of timber than turnips can attain large bulk if not thinned.

145. It is, indeed, very singular that proprietors should appoint uneducated and unskilful men to the management of their woods, while they generally are more careful in their choice in regard to men to take the management of their home-farms, although in the former appointments they have generally more at stake than in the latter. I have stated these views to several proprietors who have employed me to engage men for them to take the charge of their woods, and the only reason that I have had stated on the point was, that the services of a highly qualified man could not be obtained for such a small salary as the profits from their woods would admit of their paying. I grant that this may be quite true, but it is wrong in principle; and if true, it is the fault of the proprietors themselves that their woods do not pay them better than they do, as the more qualified the forester, the more likely are the profits from his woods to be remunerative to the proprietor.

146. The subject under consideration may be summed up thus: foresters, generally speaking, are not possessed of sufficient education to give them capacity for carrying out improvements in arboriculture; and until we have a better educated class of men reared to the profession, our woods must remain a comparatively unprofitable part of the resources of landed property. Proprietors have not taken the right way to insure their plantations being so highly profitable to them as they are capable of being made,

as they have generally appointed unqualified men to their management, from a mistaken notion that a few pounds saved on the forester's salary was economy, and a saving of expenditure; while the fact is, that from the want of skill he was yearly losing ten times more in the deterioration of the woods under his charge.

147. Were proprietors to look to their own interest, they would upon no account employ men to take charge of their woods who would do so at a low salary, as such men invariably want ability and skill to manage profitably; and, besides, they should never employ men who have not undergone proper training, and received an education fitting them for their charge. Were this attended to on the part of proprietors themselves, we should soon have a right class of men, and a class who would be able to advance the art of arboriculture to the standing its importance demands in the welfare of the country.

SECTION X.—EDUCATION NECESSARY FOR FORESTERS.

148. Having in the foregoing section shown that foresters as a body are not capable of carrying out improvements in arboriculture, from their general want of education on the subject, I now come to state what, in my opinion, should be the amount of learning a man should possess in order to qualify him to act well his part in the business of forestry. He should be a good arithmetician, so as to enable him to enter into all sorts of calculations, and to keep correct accounts. He ought also to be a fair grammarian, and acquainted with the construction and composition of the English language, so as to fit him for keeping up correspondence with his employer, and describing his views on any subject in writing, when necessary. In order that he may be able to draw plans of plantations, and measure land and wood, he should be well versed in all the common branches of mathematics. These are the common branches of an English education, which every man ought to have. But, besides, he should be able to read French, so that, when a work is published on arboriculture in that language, he may be able to read it for his own improvement in the line of his profession.

149. A forester should be able to know and describe plants and trees of any sort when he happens to see them, and when he may have occasion to write upon them. Without botany he cannot do this; he should, therefore, study this science, as, without it, it is impossible for him either to speak or to write intelligibly or correctly regarding the subjects he cultivates.

150. Of all the sciences which are necessary for a forester, and which bear upon his profession, there is perhaps none so important to his success

as that of vegetable physiology, as without a perfect knowledge of this he is as unfit to take his standing as a first-rate arboriculturist as a surgeon would be to practise without anatomy. In short, with regard to this branch of a forester's education, no proprietor should engage a man to manage his woods who is ignorant of it.

151. As different sorts of trees grow better upon the land of one sort of rock than upon that of another, and as it is necessary that every forester should know the general peculiarities of the land of one district from that of another, he should have an acquaintance with geology, as without this he cannot possibly distinguish betwixt land adapted to grow larch and pine and that adapted to grow certain hard-wooded sorts of trees, and neither can he describe intelligently the precise local position of certain districts.

152. Chemistry is another branch of science which is as useful to the pursuits of the forester as it is to those of the farmer, without which neither the one nor the other can judge correctly as to the nature of soils. This, therefore, should form a part of the education of every man who would be an intelligent and first-rate forester.

153. Of late years it has been ascertained that not a few of the diseases of trees are attributable to the attacks of certain insects, the natures of which are as yet very imperfectly known or understood. In order to enable the forester, therefore, to investigate such matters, he should study and make himself acquainted with entomology.

154. With the amount of knowledge which has been described in the six immediately foregoing paragraphs, any man of intelligence may enter upon the management of woods, however extensive they may be, with every reasonable hope of success; but without such an amount of theoretical knowledge it is next to impossible that he can, at least in order to do justice to himself, to his employer, and to his country.

155. It must not, however, be understood that only the theoretical knowledge described is necessary to make a man a good forester, as without a course of practical training besides he could not possibly be trusted with the management of woods. As well might we say that a student newly from college could practise medicine without any other preparation. What we mean is this, that besides a thorough training in all the practical parts of forestry, which can always be had on some first-rate estate where woods are acknowledged to be well kept and attended to, a knowledge of the sciences which have been described is absolutely necessary to make a man capable of thinking for himself, and to carry on improvements in arboriculture.

156. In recommending the study of these sciences to foresters, I do not mean to say that they should be perfect professors of them all, but that they

should be well acquainted with them, and to such an extent that they may be able to apply them to their business, in describing, suggesting, and carrying out certain modes of operations in order to gain certain ends. This they can always be able to accomplish from good books on the different subjects, as of such there are plenty now a days, whereby an intelligent man may teach himself.

157. It may be considered by some that, with such an amount of education as is here inferred, a man might do better than be a forester. This may indeed at first sight seem correct, but it is not so in reality, as I do not know of any one possessed of such knowledge—theoretical and practical—who is not in a first-rate situation as a forester, and who is not well paid for his talents. I believe I do not overshoot the mark when I say, that any one having such an amount of knowledge will at once get into a first-rate situation as a forester, and at a salary equal to the income of most clergymen and country doctors of medicine; and, besides, I do not think that I state too much in saying, that the very reason why there are so many foresters in situations at extremely low salaries is, that such are unlearned and unfit for better. Let as many as choose try the experiment of educating themselves as I have described, and I will warrant them getting into situations that will suit them. For there is no proprietor of extensive woods who will not give a good salary to a good man, well knowing that the result is an improved state of things on his woodlands, in every respect.

158. I have sent out a very large number of foresters to situations within the last ten years, at salaries varying from £50 to £300 per annum; and I here state that I have had the greatest possible difficulty in getting a man with practical ability combined with the necessary educational accomplishments. Proprietors are now too well aware of the value of a really good and intelligent forester not to employ him, although at a high salary; and at the present moment I happen to have a place to fill, in which £200 a-year would be given to a man with the qualifications which I have described in this section, but cannot fall in with one, so low in the scale of necessary education are foresters as a body.

159. In conclusion on this point, I would ask any one possessed of proper education, and capable of undertaking an extensive charge, to call on me, and I will have no difficulty in securing for him a place worthy of his abilities. I state this to give men engaged in arboriculture encouragement to persevere in improving both themselves and the profession.

CHAPTER II.

SECTION I.—WHAT PORTIONS OF THE COUNTRY SHOULD BE PUT UNDER TREES, AND WHAT PORTIONS SHOULD NOT.

160. There are few landed estates in this country of any considerable extent that would not be much improved in their productive qualities by the presence of well laid out plantations, especially on high-lying districts with a naturally poor soil. On flat and low-lying plains, with a naturally rich soil, it is not necessary to plant to any considerable extent, as on such districts, from the climate being comparatively mild, and from the land being well adapted to agriculture, it is more profitable, both in a private and national point of view, to rear the cereal and other crops for food than to rear timber. Even in such districts, however, it is always found desirable to plant to a moderate extent, in order to sift the prevailing winds of the spring and early part of summer, which, without a judicious dispersion of trees, in the form of broad and well-defined belts, or of hedgerows, often do very great damage both to crops and young live-stock. Only very small portions of the low-lying plain lands of this country should, therefore, be put under trees, and the extent of these should in all cases be regulated by the character of the prevailing spring winds of the district.

161. On undulating and somewhat hilly parts of the country, as well as on elevated table-lands, a much greater extent of plantations is necessary than on low-lying plains, as, in order to obtain as nearly as possible the same climate on both, shelter must be artificially added to the higher grounds, in proportion to the natural advantages of the lower. I have often seen this wonderfully exemplified in hilly parts of the country, bordering on low-lying and flat ones. On the parts of the former character I have seen the farm crops better than and as early as on the latter; and this simply from the proprietors of the low-lying districts having neglected a judicious distribution of trees on their properties, while those of the higher lying had attended to this point.

All undulating and somewhat hilly districts should then be well wooded along the ridges of the heights, in whatever direction they run, and even to some extent down the slopes on both sides, as by such means the lower grounds will be well protected from winds from all directions; but no planting should be made in the hollows betwixt the hills, at least to any considerable extent, as heavy masses of trees are always unpleasant to the eye of taste in a cultivated part of the country.

162. Although we may not be able to grow such large and fine timber on the hilly parts of the country as we can on the lower, still it must be settled that the former are the only and proper districts for the cultivation of timber to a large extent, in a comparatively small country like ours, in which we are daily finding necessity for a greater breadth of cultivated land to supply our increasing population with food. This is a fact which no wise man among us will attempt to gainsay; and with a population such as that of Britain, confined to an island such as we occupy, our object must be, in growing timber, to plant it very sparingly, and only to ameliorate the climate on all good agricultural parts, and to cultivate it extensively for all purposes for which we require a supply of wood, only on the hilly and poor lands, on which farming cannot be profitably pursued without its presence.

I state then, generally, that on all such high-lying districts of the country as will not admit of profitable farming, trees should be planted as the principal crop, and that to such an extent as to be limited only, on the one hand, by the better portions of the lower grounds being made arable, and on the other by the extreme elevation and poorness of the land not being suitable even for the growth of trees.

SECTION II.—LAYING OUT OF LAND FOR FORESTS AND PLANTATIONS.

163. A forest, in the common acceptation of the word among practical men, means either a plantation of very large extent, or a large district of country partly under trees, and partly waste. As examples in illustration of the point, I may refer to the public forests of Delamere in Cheshire, Dean in Gloucestershire, and the New Forest in Hampshire, in all of which oak has been planted, and is being reared expressly for the purposes of the navy,—to the private forests of the Duke of Atholl, in Perthshire, in which larch is grown to a larger extent than on any other property in the island,—and to those of the Earl of Seafield, in Strathspey, in which the Scots pine is grown more extensively than on any other individual property in Britain. All these forests are made up of a number of separate enclosures or plantations, of different extents and of different ages of crop.

164. There are comparatively few landed properties in this country so

large as to admit of planting to an extent sufficient to warrant the appellation of *forest* being applied to their woodlands, as I do not think that an area much less than ten thousand acres is worthy of being called by this name. This, however, is merely a matter of opinion; and as it is practically of no importance whether the woodlands upon a property be called a forest in the aggregate, or by the names of the plantations respectively, I shall leave the point to be decided by the choice of proprietors.

165. Every piece of land enclosed as woodland, whether it may be of large or small extent, if its crop be planted and not of natural growth, is called a plantation; where the crop on a piece of woodland is of natural growth, it is by practical men called a wood; and, therefore, we generally find foresters speak of woods and plantations upon a property, meaning that the crop of the former is natural to the land, and that of the latter is artificial, and had been planted on it.

166. It is admitted by every person of refined taste, that no object is so ornamental upon a gentleman's estate as an extensive healthy plantation, situated upon a well-chosen spot, and having a well-defined tastefully bending outline; and this being a point of the first importance in arboriculture, it ought to be well considered by all who would wish to excel in the profession. I am aware that many think, and indeed say, that forest trees will grow as well in an untastefully-defined plantation as they will do in one laid out upon the first principles of refined taste, provided that the soil be good enough,—which is a false estimate of what good taste is capable of doing. And in order to contradict this erroneous opinion, I do assert that a young plantation, laid out according to scientific principles, combined with good taste, will succeed much better than one laid out in a careless manner, as will be shown by-and-by, under the present head.

167. As the future welfare of a plantation is considerably affected by the manner in which it is laid out, no man ought to attempt the laying out of land for one, who is not naturally possessed of good taste for that sort of landscape scenery which is based upon the laws of nature, which will enable him to lay out the proposed plantation in such a manner as to give the greatest possible effect in ornamenting the neighbouring country. It is also necessary that the person who would lay out a new plantation should be possessed of a knowledge of the nature of the growth of each sort of tree when planted upon any given soil or situation; which knowledge will enable him to judge rightly as to the effects that certain trees will have when planted in any given spot; and he will also be enabled from such knowledge to say truly, whether or not trees will grow well in the situation chosen for a new plantation. And it is further necessary that the party, in the laying out of a new plantation, should be acquainted with, or at

least have in view, any local peculiarities of the district, relative to cold and destructive winds from certain points. From such knowledge he will be able to lay out the proposed plantation in such a manner that it shall have the greatest possible effect in giving shelter to the surrounding country, which is the principal end a proprietor aims at in having woods upon his estate.

168. The larger that any piece of plantation is, the sooner will the trees therein come to useful size, and answer the desired end; and the smaller it is, the more likely are the hopes of the planter to be disappointed. And the reason of this is obvious; for the young trees growing in an extensive plantation, as soon as they rise a little above the surface of the grass or heath, begin to shelter one another; whereas, if the plantation be narrow, the young trees can hardly be said ever to come the length of sheltering one another; for every breeze of wind blowing through the whole breadth, acts upon every single tree almost as powerfully as if each tree stood singly and alone. Therefore, it is most profitable for proprietors always to plant in large masses.

169. Trees planted in a mass of one hundred acres extent will be more healthy, and come sooner to profitable size, both as affording timber and shelter, than they would if planted in a mass of ten acres. From this it follows, that if a proprietor wishes to plant one hundred acres upon his estate, he will raise more healthy timber by planting in one mass, than he would do by planting the same extent in four masses of twenty-five acres each.

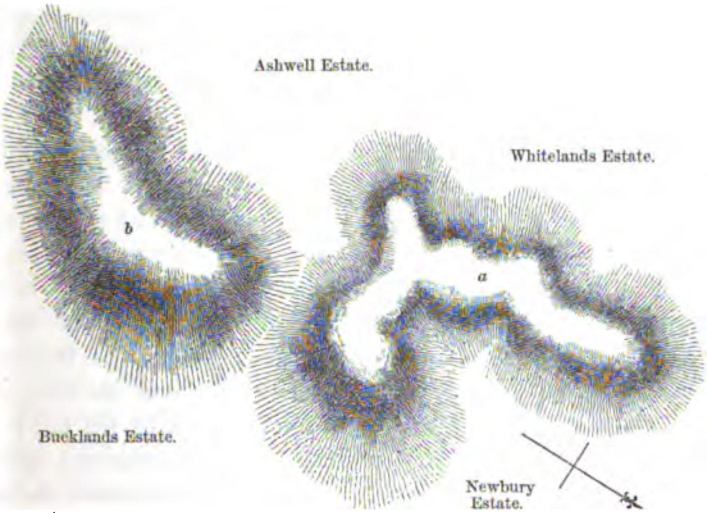
170. No young plantation, upon an exposed situation, should be less than one hundred yards broad at any given point; and, where the soil is of a light, thin, mossy nature, and not apt to raise trees to good size, one hundred yards may even be too little for breadth. If there be much mossy ground upon the site intended for a new plantation, or if there be much of it consisting of poor, thin, gravelly heights, as is often the case in unimproved districts, a narrow or small plantation will not succeed profitably. A small plantation may succeed upon a good loamy soil in a sheltered situation; but upon a thin soil, and an exposed situation, I would advise not to plant at all, unless it be done in large masses, say from four hundred to one thousand or more acres.

171. Almost every gentleman's estate lies in a manner peculiar to itself; the wind that might prove hurtful to one estate might not do so to another marching with it; therefore it is that the particular winds which prove most hurtful to an estate should always be taken into consideration in the laying out of a plantation upon it.

172. By referring to Fig. 1, this peculiarity in the difference of situation affecting landed property will be at once evident.

The estate of Whitelands being situated upon the west side of the hill *a*, which runs nearly south and north, would be greatly sheltered from all storms of wind from the east and south-east; consequently, in laying down plantations upon the estate of Whitelands, the greater length of the same, in order to protect the land from the north and south winds, would require to be made from east to west; and if the situation were exposed to destructive west winds, plantations meant to protect the lands from it would require to be made from north to south. Again, Newbury estate, being situated upon the east side of the hill *a*, the lands upon it would be sheltered from the west and south-west winds, but would be much exposed to the north and east winds; consequently, the same estate would require to be sheltered by plantations, extending their greater length from east to west, which would protect the lands from the north winds; or from north to south, in order to protect from the east winds.

Fig. 1.



173. There being a considerable opening between the south end of the hill *a* and the north end of the hill *b*, as indicated in the figure, the north part of the lands of Ashwell occupying the west side of this opening, and those of Bucklands occupying the east, great care is necessary in laying down plantations under such circumstances; for either the east or west wind passing through such an opening, gathers force from being confined in its passage between the two hills; therefore, in order to protect each estate from the effects of winds passing through unchecked to either side, a mass of plantation would require to be situated right in the opening,

having a convex side turned to the east, and another to the west, which would naturally turn the wind to either side, and cause it to spread along the hills.

Again, in order to protect the lands upon the west of Ashwell from the north, plantations would require to be laid off from east to west; and in order to protect them from the west, they should be laid off from north to south.

Upon the estate of Bucklands, again, the land requires to be sheltered more particularly from the north and east winds; therefore plantations laid out upon it with the view of protecting from these winds would require to be made from east to west in the one case, and from north to south in the other.

174. From what has been said, it will appear plain why one estate may be injured by the wind from a certain point, while another marching with it may not be injured by the same at all. Thus the estate of Whitelands, from being situated upon the west side of the hill *a*, is completely sheltered from the east wind; while, on the contrary, the lands of Newbury are naturally exposed to the east. The northern parts of both the estates of Ashwell and Buckland are, from their natural situation upon the opening between the two hills, nearly alike exposed to the east and west winds; while the southern parts of these estates are sheltered by the hill *b* differently; therefore it is that, in the laying out of plantations upon any landed property, those matters which I have here endeavoured to explain by reference to Fig. 1 must in all cases be kept in view by the intelligent forester.

175. I have already said above that the welfare of a young plantation depends in a great measure upon the manner in which it is laid out. I also said that a plantation laid out according to scientific rules, combined with good taste, will succeed much better than one laid out in a careless unscientific manner. The following are the rules by which I generally guide myself in the laying out of a new plantation:—

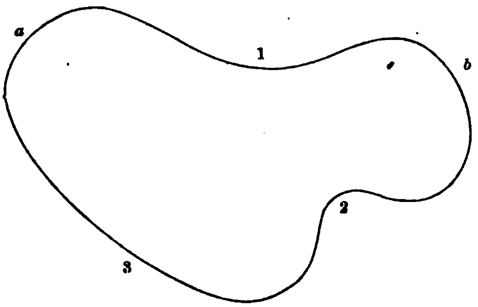
First,—In laying out its boundary line, avoid all straight lines upon the exposed sides; and, if possible, make no straight lines upon any side; they are disagreeable to the eye, and are without meaning when applied to natural objects: in nature there are no straight lines, and that for a wise end, for they are without strength to resist outward pressure.

Second,—The greatest extent of a new plantation should be laid off against the prevailing wind of the district; and, at the same time, the greatest extent should be kept along the highest part of the ground to be planted.

Third,—The best possible form of boundary line which can be thrown out against the wind, upon the most exposed side of a plantation, is the convex. Such a form of boundary line weakens the strength of the wind when it strikes upon it; the strength of the storm is, as it were, divided by the projecting bend of a well-defined convex.

Fig. 2 is a sketch of the outline of a plantation with its exposed sides *a* to the north, and *b* east, representing two convex bends thrown out against the storm from those points.

FIG. 2.



Now, from considering this attentively, it will at once appear evident that trees growing behind a bend of this description, and the outer trees forming themselves the bend, are, from the position in which they are arranged, proof against the effects of storm, as compared with others forming a straight line, or a concave bend. Upon the convex bends, as at *a* and *b*, Fig. 2, when the wind hits, its force is weakened, because the line of fence recedes from the wind, as it were, at any given point; and in proof of this I may refer to the action of the sea upon the different shaped bodies which may be made to pass through the water. For example, the forepart of a ship is nearly of the convex form, and when the water strikes upon it, it spends itself along each side of the vessel. Again, were a ship to have its forepart made flat, it could not be urged through the water at all; and further, were it made concave, instead of the vessel being made to go forward, it would be driven back. This is exactly the principle of the action of the wind upon the different forms of fence-lines; and from this we see that the concave bend is the worst for the purpose of protecting from the storm anything behind it; consequently, in making such a bend in the line of a plantation fence, great discrimination is requisite to know when it should be made.

Fourth,—Upon the most sheltered sides of a plantation the boundary line may be made to bend one way or another, as good taste may direct, but in all cases making a concave bend only where there is a good breadth of planting immediately behind it.

By glancing at the concave bend 2 in Fig. 2, it will be observed that it is backed by a great breadth of planting from the north *a*, and is also well protected by the convex bend *b* upon the east; besides, its situation is upon the most sheltered side of the plantation—namely, the south; and such concavities may be made upon the same principle, few or more, according to the extent of the ground planted, and also as the private taste of the proprietor may suggest. In general cases, the fewer of them the better for the welfare of the plantation; where stock are to be sheltered, it is often necessary to make them. For example, if in Fig. 2 there was no concavity at 2, the storm blowing from the east, cattle could have no real shelter along the edge of the wood at that point; but in such a bend in the outline of a wood as shown at 2, stock could not receive any injury excepting from the south, which is, generally speaking, not subject to stormy weather in this country.

Fifth,—The highest parts in a neighbourhood, if they are not too high to admit of trees growing profitably upon them, ought to be chosen for the site of a plantation. By choosing such a situation, the greatest possible shelter is likely to be attained for the fields of the neighbouring country; and, at the same time, a plantation situated upon a height always forms a prominent and a pleasing object to the proprietor. A bare height, at only a moderate elevation, always carries along with it the idea of barrenness; but when planted with trees, it forms one of the most pleasing objects in the landscape of a gentleman's estate.

Sixth,—In the laying out of a new plantation in a high exposed country intended principally for the protection of live stock, there ought to be several rather deep sinuosities upon the most sheltered sides. These sinuosities ought to be upon a bold wide scale, so as not to cause any weak point to project from the body of the plantation; for if this be the case, such weak points would not thrive, and consequently always have a mean appearance.

Seventh,—If in the general arrangement of the boundary line it should be found necessary to make a bend, having its concavity to the storm side, care should be taken to construct such a bend in a hollow part of the ground, or at least as low as possible; and it should be backed by a good breadth of planting behind. See Fig. 2 at 1.

176. In the laying out of a new plantation, there is much room for the display of good taste. Every person is pleased with the effect of well-arranged figures upon grass in a flower-garden; and the several plantations upon a gentleman's estate ought, in like manner, to be well laid-out figures, upon a large scale. Many have told me, when speaking upon this point, that it is superfluous to lay out a piece of plantation with as much view to taste as is necessary in garden and pleasure ground scenery; but I have always maintained that taste is as necessary in the one case as in the other, and that any proprietor has a right to tasteful arrangements, and is pleased therewith when surveying his farms, as much as with the other when surveying his pleasure-grounds. If in the general arrangement of a

young plantation, a display of taste were to be injurious to the welfare of the same, then I would say, let taste have nothing to do in the matter; but the truth is quite the reverse of this. All true taste is based upon the works of nature; therefore, when we make the bendings and turnings of the boundary line of a plantation in conformity with the securing natural strength to resist the storm, we at the same time give the most pleasing effect to the mind of the person who looks upon it.

177. The bendings in the outline of a plantation should always be made to follow the natural rising and falling of the ground—that is, where any lateral heights may project from the main body of the land laid out for a plantation, make the fence-line take a bold convex turn in the same direction, and that just so far as may be considered necessary for the extent in view; and where a hollow of the ground occurs, make the fence-line take a bold concave turn there, coming up again in the form of the convex where the ground begins to rise.

Fig. 3.

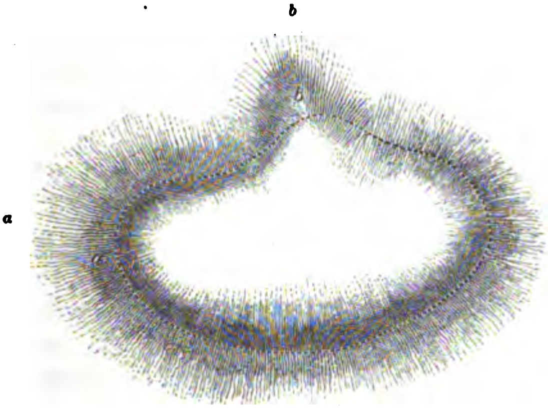
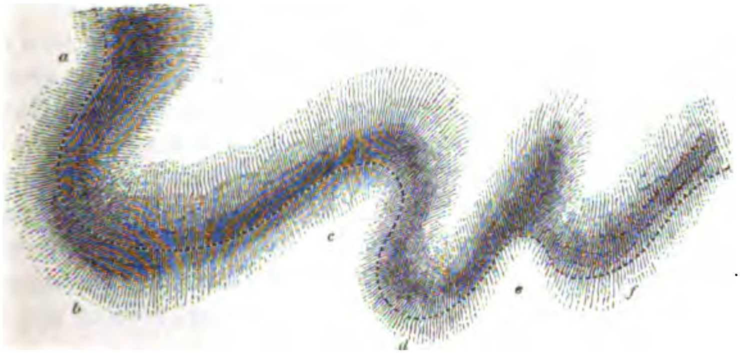


Fig. 4.



This will be more fully understood by referring to Figs. 3 and 4.

Fig. 4 represents the side of a hill as laid off by me for a plantation, and the dotted line represents the fence. The concave bend *a* is made in a hollow, sheltered part; and the convex bend *b* rises over the high ground adjoining, but is not extended to the extreme tail or bottom of the hill ground; because it may, and often is, found extremely advantageous to retain a part of such high ground in the field, in order that sheep and other stock may have the benefit of the same for lying upon at certain seasons of the year when the lower grounds may be in a damp state; and besides, I have already said that the bends need only be extended so far as may be considered practicable for extent and general purposes, but in all cases the retaining of the form of the natural ground should be kept in view. The concave bend *c*, it will be observed, is made to extend far back into the hollow ground; for such a hollow part, when sheltered by plantations nearly all round, is one of the greatest benefits possible for stock at all seasons, both as regards storm in winter and shade in summer, and more particularly if the bottom there be dry.

The convex bend *d* is again extended beyond the tail or bottom of the hill ground, and that in order the more effectually to add shelter to the adjoining hollow part *c*; and the same remarks apply to the concavity *e*, which is also much sheltered by the bends *d* and *f*. Now, these points are most necessary to be attended to in the laying out of woodlands upon hill countries, where, indeed, the welfare of stock is often more to be taken into consideration than the giving of mere shelter to field-cropping.

Fig. 3 is the representation of a hill which it is wished to form into a plantation in an exposed district. At *a* the hill-ground runs out to something like a mere point, and in this case the line of fence is kept a little higher, in order to give the convex bend a bolder and wider turn; for I have already said that all weak projecting points ought to be avoided in the proper laying out of a plantation boundary; and had the fence-line at *a* been brought out in the exact natural form of the tail of the hill, a mere point would have been made, which should, in all cases of this nature, be avoided. And the very same remarks apply to the projecting point of the hill at *b*, where the fence is also kept back in order to strengthen the interior; and by the same being thus kept a little back, the appearance is improved, and yet in all these cases the natural form of the hill is retained.

178. In the laying out of a new plantation, if it is at all to be seen from the windows of the proprietor's mansion, or from any part of his pleasure-grounds, great care should be taken to make it have the most pleasing effect when viewed from such points; for if it should be badly laid off it

will prove a continual eyesore, and if well laid off it will prove a constant source of pleasure.

179. Besides the converting of hill-ground into plantations, there is also to be considered the planting of glens and other local hollows, which would be otherwise of very little value to the proprietor for any agricultural purpose, but which, if at all adapted to the growth of trees, under skilful forestry may be made the most profitable of all situations for the growing of timber. And, relative to this, I must say, that even upon a very inferior soil, trees will succeed far better upon slopes and in hollow parts than they will do upon a rich piece of land situated upon a level country. This appears to be most natural to the welfare of trees in general, which is a wise provision of nature, seeing we cannot cultivate such land profitably in the rearing of any other crop.

In the laying out of such hollows or glens for the rearing of plantations, I may remark here that the fence or boundary line ought to be made for the greater part to follow the undulations of the brow of the glen—that is, the boundary line of the ground to be planted in the hollow should be made to correspond, so far as other local circumstances will allow, with the natural line of the tail of the background above and the head of the slope; for this is the system which gives the most pleasing effect. But in saying this, I by no means wish to be understood as advocating that nothing ought to be done in order to improve upon the natural appearance of such irregularities as we often find existing along the edges of hollows or glens; on the contrary, there is no part of forest architecture in which there can be more taste displayed, not only with the view of giving effect, but with the more important view of giving the benefit of increased shelter from storm to the cultivated grounds along the sides of such parts.

It is well known to all country people, that in glens or hollows of any extent there is generally a draught of cold wind rushing along when the same is not sensibly felt upon the higher grounds above—at least at any considerable distance back from the brow of the hollow; and such cold winds are often very hurtful to crops in the adjoining fields, particularly in the case of frost and cold damp in the spring months. Now, in order to prevent the evil effects of such draughts of damp and frost winds in the spring, it is very proper to have convex bends rising out of the glen or hollow, at well-chosen points, and extending a considerable way upon the level ground above, and always endeavouring to bring up such a bend at a part most likely to intercept the rush of wind from the glen to the higher grounds; and such bends should not be made upon a small contracted scale, but to a considerable extent, by which means the ground above is greatly protected from the effects of sudden gusts of wind, which are very apt to arise from such parts, and which are almost always hurtful.

180. Many maintain that the planting of hollows with trees adds very little to the shelter of the neighbouring country; but in this I am decidedly of a different opinion; for the very existence of trees in a hollow sifts the wind passing through it, and very much impedes its passage and softens its temperature; more particularly, when projecting parts are made to jut out at proper and judiciously chosen parts upon the level country much good is done. And not only do such juttings prove beneficial as regards shelter, but they, in my opinion, add greatly to the general effect of the whole, as appearing most natural, and agreeing with a refined taste.

181. The method of laying out plantations in the form of strips, so often to be met with in Scotland, gives a poor and mean appearance to an estate, particularly when found about the home grounds. The form in which they have generally been made is in straight lines, from twenty to thirty yards broad. In such narrow belts of wood the trees are very seldom found in good health; and, upon a little consideration of the matter, this is not to be wondered at—because, from the narrowness of such strips, the proprietors were always afraid to thin them, wishing to keep them in a thick state, in order to give as much shelter as possible; and the natural consequence is, from being left too thick, the one tree soon kills the other. And even where such strips have been well managed, it cannot be expected that they could produce either good healthy timber or make a good shelter, for, being so narrow, the trees never come to shelter one another. But it is a happy circumstance in the history of arboriculture, that few such strips are now planted. Gentlemen are now beginning to see the impropriety of such a method of raising plantations; and now, in almost all cases of good management, we see the old-fashioned narrow strip giving place to the well-defined extensive plantation, which is, indeed, the only profitable way of rearing trees for any useful purpose.

The above assertion, I am aware, will be considered by many too sweeping a condemnation, and as having reference to all plantations in the form of strips; but in what I have said above upon this point, I have simply stated the objections which I have to the system of planting trees in too narrow strips, with the idea of growing useful timber in them; and I do further assert, that narrow strips are, above all other forms of plantations, the least likely for the rearing of timber to a profitable and useful size. However, there are many proprietors who, from circumstances of a local nature, are inclined—and I may say are often obliged—from the want of space, to plant in the form of strips; and, for the guidance of such proprietors, I beg to submit the following observations upon this point, which may, in many cases, be found useful:—

In all cases of planting strips in a moderately exposed country, if they are made nothing less than forty yards in breadth, they may, if well managed in the after rearing, be made to produce good and useful timber; but much under forty yards, I think, it is not advisable to plant strips, at least with the view of ever producing either valuable timber or permanent shelter.

182. It often happens that upon small landed properties it is deemed of the first importance to have the greatest possible extent under farm-cropping; and, at the same time, it is also a matter of great importance to have the land subdivided by narrow strips of wood, in order to produce shelter. In cases of this nature there is, indeed, necessity for taking up little room or space in the form of plantations; and in such cases I would recommend the following profitable method of rearing hedgerow timber upon small properties:—

Wherever it is found of importance to have a strip of plantation much under forty yards to shelter a part of an estate, and where the land is considered too valuable to have much of it converted into plantation ground, let the strip of land intended for the same be laid out and fenced in the usual manner. In planting this strip, let it be considered what sort of hard-wood trees will thrive best as a permanent crop upon the land; and if the soil be of a moderate quality, we will say a mixture of oak, ash, and plane. Let a row or line of these be planted immediately behind the fence, upon the most sheltered side of the strip, mixing them regularly, and at distances—say twenty feet apart; or plant one sort continuously for a certain distance, if that should be considered necessary, upon consideration of a variety of soil occurring in the line, and, having done this, make up the body of the strip with such trees as may be considered proper upon account of soil and situation, and of kinds that will be most likely to produce shelter quickly, and be profitable in the cutting down entirely as thinnings. Let such a strip of plantation be carefully managed, and as directed for other plantations in another part of this book, paying particular attention to the proper pruning of the line of hard-wood trees behind the fence, keeping the others well off them as they advance; and, in due time, if they be attended to, they will make rapid progress, being situated upon the sheltered side. I may say that, by the time they may attain thirty years of age, they will be strong, spreading, vigorous, and hardy trees; and at this stage, if the body of the strip have been kept rather thin of trees in order to make the row of hard-wood upon the sheltered side hardy by degrees, the whole of the trees in the strip excepting themselves may be cut down, and the hard-wood alone left as a line of hedgerow timber.

Now, relative to this, it may be asked, why plant a strip at all, when only a row of hedge timber is intended to remain ultimately? In answer to this, I have to say that, had the hard-wood trees been planted alone, without other trees in the form of a strip to shelter them for a time, they would have made but slow progress, and possibly might have been as long again in attaining a size fit for shelter; besides, the proprietor has, in this case, the benefit of early shelter by planting in the form of a strip in order to nurse his permanent trees, which shelter is continued by the advanced state of the hard-wood trees after all those in the strip have been removed; and he also has the value of the nurses to pay him at an early stage. Now, the advantages of this system over the common way of rearing up strips are these: Where narrow strips are planted with the intention of remaining as such for an indefinite period, we in most cases find the trees in them weakly and worthless, from being too much drawn up, and this state of the trees is occasioned by the want of space in the breadth of the ground allowed; and, generally speaking, by the time that the trees in such narrow strips have attained forty years, they begin to decline, and the strip becomes a mere waste. Whereas, when there is one line of hard-wood trees planted upon the sheltered side of such a strip of plantation, it is at once understood that they are to be the object of the cultivator's attention for permanent shelter; and seeing this, he is not afraid to cut and thin other trees near them, which is the very state of things wished for; and if the row of hard-wood trees be allowed ample space, and paid attention to, they will, by the time that the trees in the other part of the strip are failing, be in a healthy and most useful state for remaining as valuable hedgerow timber, and will prove a beneficial shelter to the fields for generations after their nurses have been taken away. Another advantage of this system is, that the proprietor reaps a good rent for his land from the sale of the trees cut down, independent of leaving a row of permanent timber trees, which will act better as a shelter to his fields than his strip ever could have done as treated in the usual manner; and he has also the double advantage of again bringing his land under the plough after the crop of wood has been removed, which he could not have done had he allowed his strip of plantation to remain in the usual manner. And in conclusion upon this head, I beg to say that I have, in all cases of good management, found hedgerow timber infinitely superior in every respect to narrow strips of plantation, even where such were under what might be considered fair management. Trees in narrow strips seldom live to great age, from the want of space, even when tolerably managed; whereas hedgerow trees, when reared in the manner

I have stated—which is applicable to high parts—attain, from having ample space, their full natural vigour and dimensions, and live to double the age of trees found in a strip; and when allowed to grow rather closely together, they make a much better shelter than an unhealthy strip. Therefore it is, that in all cases where land is considered of great value for farm-cropping, and where strips cannot be made of sufficient breadth, I would recommend the planting of hedgerow trees in preference to the usual method of planting narrow strips, and that either in the way I have recommended, or in a fence-row at once, if the climate and soil be good.

SECTION III.—UTILITY OF FENCING AND PROPERLY ENCLOSING LAND FOR THE GROWTH OF YOUNG TREES.

183. It is absolutely necessary that every piece of land laid out for a plantation should be fenced in some way or other previous to its being planted. A fence not only prevents the inroads of sheep and cattle, but it at the same time tends very much to shelter the young trees, and to bring them on rapidly. It is indeed surprising to observe the difference that a very low fence makes upon the growth of young trees, as compared with those which are not protected by one. Any proprietor or forester, upon looking through his several plantations, will observe that in all young plantations the most rapid growing, and at the same time the most healthy trees in it, are to be found immediately behind the outer fence; and, on the other hand, in all older plantations, the best grown, and at the same time the most healthy trees, are to be found in the centre of the same, or at least a considerable distance back from the fence. Now, it may be asked, what is the reason that the best wood is found in the inner parts of old plantations, while the most rapid growing trees are to be found, when young, behind the boundary fence? The reason, as proved from experience, is this:—

During the first eight or ten years of the age of any young plantation, the boundary fence is the only shelter that the young trees have; and it is evident that those trees which grow immediately behind the fence will receive most of the benefit of its shelter; consequently, from the circumstance of their receiving more shelter than their neighbours further off, they must grow more rapidly, until such time as their tops begin to rise above the level of the fence, when they are considerably checked by the cold winds. At this stage they begin to grow thick and bushy, rather than advance in height; and immediately upon their becoming so, they begin to shelter all their neighbours inside, which again begin to have double the advantage of their neighbours outside; for the trees upon the outside had shelter only so long as they were below the level of the top of the fence; whereas those inside have now a shelter which every year increases upon them for their advantage, in height as well as in thickness. All this comes in to prove that a fence is a great means of furthering the healthy development of a young plantation, independent of its protecting from the inroads of cattle at the same time. I always calculate that a plantation with a good fence is ten years in advance of one without such protection.

184. It may not be out of place here to state the great necessity there is for keeping good all fences which surround plantations, to a period beyond that at which it is likely that the trees will be injured by the access of sheep and other live stock; and more especially as I have often had occasion to remark the evil effects of sheep in particular being allowed to have access to plantations at an early period, I find it the more incumbent upon me to point out the evils arising from such a habit being allowed upon many estates.

185. Upon many gentlemen's estates I have observed sheep and other cattle grazing in hard-wood plantations not above twenty-five years old, and this was allowed under the impression that the rent which was received for the grazing did more than any additional benefit which could be derived from an opposite system of preserving the trees by fences. This, however, I beg to say, is a practice very injurious to the welfare of any young plantation; for sheep, in particular, when allowed to have free access into any plantation composed of trees in a growing state, and having their bark smooth, are certain to injure the same, from the greasiness of their wool coming in contact with the bark and impeding the action of light and air; and, under such circumstances, I have frequently had occasion to see many fine and apparently healthy trees die suddenly. Upon the other hand, heavy cattle, when allowed to graze in a plantation of small extent, among growing trees, are always inclined to hang about under their shade in the warmer part of the day, at which periods they invariably commence gnawing the bark, which is smooth upon such young trees, as well as the shoots of the tender branches where they can reach to them. Therefore, I would advise all proprietors, as they value the welfare of their plantations, never to allow cattle of any description to have access into a plantation, unless the trees in it are considerably advanced towards maturity, when the bark of most forest-trees becomes hard and covered with rough scaly protuberances, which resist the action of either the greasiness of the sheep, or the teeth of large cattle. It may be asked, at what stage would it be safe to allow the grazing of cattle to take place where trees are? In answer to

this, I give it as my opinion, that after trees have attained the age of nearly forty years, and have received their final thinning, they may, in the generality of cases, be considered safe from the inroads of cattle.

186. Many different methods of fencing have been adopted for the enclosing of young plantations, &c., upon landed property, and, no doubt, different methods will still continue to be adopted, according to the different sorts of materials to be had in abundance in the neighbourhood of the plantation or other enclosure which may require to be protected; and as fencing is very often a very important part of a forester's duty, I shall, in the following sections, enter rather minutely into detail upon the method of erecting the different sorts of fences, and shall show the advantages of one sort over another, in so far as they are suited for different purposes, and for different situations, with any other particulars relative to them that may be useful to the practical forester. And before leaving this section, which is merely meant to point out its advantages, I may be allowed to say that every practical forester ought to make himself as nearly as possible master of the art of fencing in all its most useful parts. Having myself, in the act of visiting gentlemen's estates, seen much of the great advantages derived from men acting as overseers upon estates being well up to this sort of work, as well as the disadvantages to proprietors of having men as overseers who were not well acquainted with it, I am the more anxious that this art should be properly understood both by foresters and land-stewards ; because, from possessing such knowledge, they are the better able to be intrusted with the improvements which may be carried on by the proprietor in whose service they may be employed. I shall not confine myself strictly to the description of fences which may be considered adapted to the enclosing of woodlands: I shall also point out the method of erecting fences adapted for parks and pleasure-grounds, the knowledge of erecting which is often as essential to the forester and land-steward as that of cultivating the soil for their respective crops.

SECTION IV.—MANAGEMENT OF THE DIFFERENT SORTS OF HEDGE FENCES.

187. There is no fence more generally in use in the cultivated districts of Britain than the thorn hedge ; and considering its permanent nature as a fence upon good land, it is certainly the best adapted for most purposes where a neat and clothed appearance is the object. The hedge is very much improved by having one-third of beech plants mixed among the thorns in planting, and this more particularly upon high situations with a light

soil. There the thorns are very apt to die early; but when mixed with a proportion of beech plants, which thrive well in a light soil, the fence is much improved both in health and appearance. The soil upon which I have found the thorn thrive best as a hedge fence, and in which it is likely to live to a great age, is a heavy loam upon a dry bottom. In all light soils, such as moss, sand, or gravel, thorns are very apt to die suddenly, if not attended to very carefully in the way of regularly cutting and cleaning, once a-year at least; and it is in order to prevent this tendency of the thorn to die prematurely in such situations, that I recommend a mixture of beech to be planted among thorns in a hedge. I have frequently had occasion to observe, that even where a thorn hedge had failed to succeed in a high situation upon a light soil (being a mixture of gravel and moss), when I had it repaired by a mixture of beech plants the thorns recovered, and made an excellent fence along with the beech; and this I believe to be principally owing to the effects of shelter produced by the beech retaining its leaves during winter and sheltering the thorns; besides, the beech, being fond of a light dry soil, throve well and supported the thorns.

188. Many recommend the practice of manuring poor light soils, for the reception of thorn plants, in the forming of a hedge fence; but this I can by no means approve of; and I mention this circumstance in order to put the inexperienced upon their guard. I have often had occasion to observe, that those hedges which were planted with manure in a naturally light poor soil, and upon a high situation, did indeed grow freely for the first two or three years after planting; but as soon as the manure had lost its effects upon the plants, they fell into a state of bad health; and in the course of five years from the time of planting, such a hedge was much inferior to others which had received no manure upon the same soil and situation. The best manure for thorns in a light soil is a good dressing of clay or heavy loam, if it can possibly be had; and if that cannot be got, plant beech instead of them in the natural soil, as this plant will be sure to succeed if attention be paid to keeping clean in summer and cutting in autumn or spring.

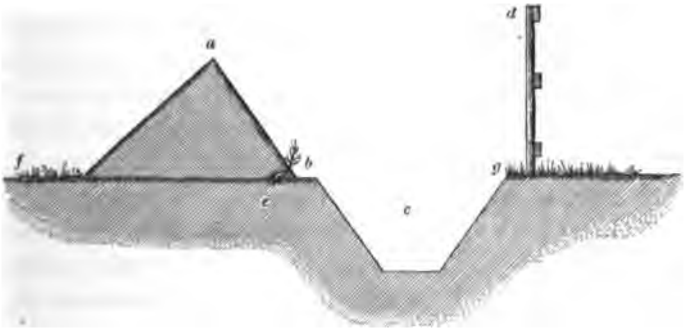
189. As the thorn is a plant better suited for hedges in agricultural districts in this country than beech or any other plant we are yet acquainted with, where the soil is at all suitable to it, it should be planted alone, and without any intermixture whatever. This may be done on any description of land varying from a light loam to a clay, but not upon land that may be termed lighter than the former. If much lighter, or approaching to sandy loam, a mixture of beech should be used with the thorn, and if sand or gravel, beech alone should be used.

190. In the planting of thorn and beech hedges, two methods are prac-

tised, according as the soil may be damp or dry. The one method is that of planting the hedge on the brow of an open ditch, made at the same time for the purpose of keeping the roots of the hedge dry and for collecting and carrying off water from the field or plantation which it surrounds. The other method is that of planting the hedge upon the surface of the soil without any ditch whatever; and either of these methods may be adopted according to circumstances; although, for my own part, I am decidedly in favour of the latter method, as being the most neat and least expensive in executing, as well as taking up much less room in the field; and where the soil is rendered dry it thrives better.

Fig. 5 is a section of a hedge planted upon the brow of a ditch; and by referring to it, the method of planting the same will be easily understood.

FIG. 5.



191. In executing the work of planting a hedge of the description shown in the above figure, the operator first stretches his line along the run of the ground where the hedge is to be planted, and which it is understood has been previously set off by pins driven into the ground; but instead of placing the line in the exact run of where the hedge is to be planted, the operator pins it down about five inches to that side of the run upon which the open ditch is to be made. He next proceeds to level and clean from all weeds, &c., with the common spade which is used in doing this work, the surface of the ground, all along upon the run or hedge line, as far as his line has been stretched, to the breadth of about twenty-four inches back from his line; and having done this, in a manner to correspond with the rising or falling of the ground in the run of the hedge, observing to level up or reduce any sudden inequality, he next proceeds to mark off carefully the edge of the ditch upon which his line was first stretched; and in doing this, the operator turns his face to the side where the ditch is to be, and with his foot he forces the spade pretty deeply into the ground, cutting the surface exactly all along by the line; but he must observe not to cut

perpendicularly with the spade, but to cut with a considerable slope to the ditch, in order to form part of its side, as may be seen by glancing at Fig. 5, where *b* represents the point upon which the line rests, with the slope of the ditch under; and when he has finished the cutting of the one side as directed, he will lift his line four feet to the opposite side, in order to form the other side of the ditch, as at *g*, observing to make the second cut exactly parallel with the first; and in the act of cutting, he must turn his face again to the ditch, in order to form the opposite slope. Both sides of the ditch being marked off, the operator with his spade next raises the turf, or whatever the surface may be, but which should be always cleaned from weeds, the outer edge of which he first marked off at *b*; and, lifting it up, he turns it upside down upon the part which he formerly levelled for the planting of the hedge, which part is now termed the *bed*, as at *e*, upon which the roots of the young plants are to be laid; and in doing this part of the work, five inches of the level part must be left between the side of the bed and the edge of the ditch, which is termed the *scarcement*, and is meant to support the bed firmly, as well as to prevent the rolling down of loose earth from the bank *a* into the ditch *c*; therefore the operator, in lifting the soil from the edge of the ditch in order to make up the plant bed, must keep it regularly five inches back from the edge; and in preparing the bed for the reception of the roots of the young plants, it must be made three inches above the level part or scarcement, upon the outside, and this in a compact level manner, and must slope backwards from the outer edge at an angle of about forty-five degrees. (See Fig. at *e*.) And this in order that the roots of the plants may not be flat, but dip into the earth, and that their tops may incline a little upwards.

The bed and scarcement being finished, as has been directed above, and made perfectly clean from weeds, the next part of the work is to have the plants prepared for putting in; and as it is presumed that the plants—say thorn and beech—have been brought forward in due time and put into the earth by the roots in a dry part near the work, the operator will bring them forward, and before putting them into their bed, he will, with a pruning-knife, and not with an axe, as many carelessly do, cut every thorn plant down to within about four inches of the top of the root—or in other words, leaving only four inches of the stem of each plant. But with regard to the beech plants, if any are to be planted among the thorns, they must not be cut at all, not even the tops; for they do not succeed well if cut at this stage; and beech plants for this purpose may be from eight to twelve inches high. Having the plants thus prepared, the principal operator will take a few plants, both of thorn and beech, in his left hand, and with his right he will lay the plants upon the slope or bed prepared for them, putting in successively two thorns and one beech, at the distance of about ten inches, plant from plant. In laying the plants upon the bed, the top or cut part of the thorn may be made to project over the outer edge of the bed about two inches, which part will set away young shoots to form the hedge; but the beech must be allowed to have all their top part lying out, with their roots upon the same level with those of the thorns.

As the principal operator or workman proceeds in thus laying out the plants upon their bed, another careful person follows him, and, collecting the finest of the soil from the part of the ditch opened in making the bed, he puts it upon the roots of the plants, covering them very carefully, and using caution in order not to displace any of the plants while lying in their uncovered state; a third man follows, who puts on another spadeful of earth from the surface of the ditch all along upon that put on by the second man, which second spadeful will be enough to cover the roots securely; and when this is finished, the whole of the soil thus put upon the roots of the plants should get a firm tramping with the feet, in order to make the plants secure in their place, and exclude the drought from the roots. This being done the whole length of the line, the whole of the earth contained in the ditch *c* is then thrown out and made to form the bank above the roots of the plants, in the shape as seen in the figure at *a*. The ditch is generally made four feet wide at top, and fifteen inches at bottom, and two feet deep; and the size of the newly formed bank, which is made from the earth taken out of the ditch, will be nearly two and a half feet deep at the point above the plants at *a*, and from four to four and a half feet wide at the base. After the earth has been all thrown out of the ditch, and it is properly formed, smooth upon each side, and level in the bottom, the bank should next be formed to nearly the same slope as the edge of the ditch under it; but as it is formed of loose earth, it is better to keep the slope of the bank a little flatter than that of the ditch under; and in order to prevent any of the loose earth tumbling into the ditch from the bank, it should be tramped and made firm as the work proceeds. And when the whole is finished, it should receive a firm clapping by means of the back of the spades, which keeps it all firm and smooth above.

In the finishing, the level scarcement ought to be left in a clean and neat manner, without any roughness lying upon it; and the tops of the thorns should all project regularly, and the soil be made firm about their necks. In this manner the whole line of hedge is to be done, one line-length after another; and when the whole is finished, a three-barred paling ought to be put up upon the outside of the ditch, in order to protect the young hedge from the inroads of cattle. The paling, when put up, will require to be kept good until such time as the hedge becomes a proper fence of itself, which, upon an average, may not be till it has grown nine or ten years.

The method of growing hedges, as has been directed above, is excellently adapted to land of a wet character, or rather where the draining of the land has not been attended to; for no thorn hedge will succeed unless the ground upon which it is planted be rendered dry; therefore, if the ground where a hedge fence is to be planted is either not naturally dry or not made so by artificial drainage, the plan as above detailed must be resorted to. Besides, it often happens that, in the laying out of ground for a new plantation, the drains in it require to be run into some large ditch, in order to act as an outlet for the water; and in this case the system of fencing with a ditch answers well — that is to say, all other circumstances corresponding; and in such a case, the ditch requires to be placed next the wood, with the hedge and bank outside, with the paling upon the outer tail of the bank, as at *f* in Fig. 5.

In Mid-Lothian I get hedges of the description above specified planted, and every part of the work done in a complete manner, for 10d. per rood of six yards; and the plants for the same length will cost about 6d.

192. I shall now refer to the other method of planting hedges, namely, that of planting in the surface soil without any ditch whatever. In all cases where the land is either naturally dry or has been rendered so by artificial drainage, and where there is at the same time no necessity for any ditch as an outlet for water from drains, &c., made in the neighbourhood, whether that may be in the case of an adjoining field or a plantation, I would advise not to plant hedges in the form of ridge and ditch, but simply in the common soil of the line of fence required. In planting a hedge in this manner, I have the ground trenched in the line of the hedge to be planted, four feet wide by twenty-four inches deep; and in the act of digging, I have all root-weeds carefully picked out, which ought to be particularly attended to in the planting of all hedges, seeing that the eradicating of such afterwards has a tendency to disturb the roots of the plants too much, and check their growth by admitting too much drought. When the whole length of the ground for the intended hedge has been thus prepared by trenching and cleaning, I have it very nicely levelled by the eye, in the first place; and when I consider the ground to be nearly as level as I wish it, I next stretch the line along the middle of the ground, stretching it pretty tightly, in order that it may tell the level by its tightness; for where the ground is hollow the line will be above it; and where the ground is high, the line will be lying too close upon that part. And having the line thus tightly set, I go upon it with my feet, keeping it right under the middle of the

soles of my shoes; and in this position I tread the earth firmly, walking sideways all along the length of the line; by doing this, I have the soil firm about five inches upon each side of the line. Coming off at the end of the line, which I allow to remain, I make up with fresh soil, from one side of the line, any inequalities caused by my feet in walking along, and beat the new surface with the back of the spade as I proceed, keeping about seven or eight inches in breadth level on the one side of the line, and only about two or three upon the other. This being done, I next take out an opening with the spade upon that side of the line which has the least level ground upon it, and this opening I make about nine or ten inches deep, according as the roots of the plants may require, taking care to have the opening neatly cut by the run of the line. I next have the plants prepared as formerly stated, and put them in along the side of the firm level edge, observing to keep the stalks of the thorns about two inches above the surface, and the beech plants all the height, as formerly stated; then fill in the earth, and make the whole firm and level, which concludes the work of planting the hedge.

193. In comparing the two methods of planting hedges just described, I have found that by the last mentioned system the plants come much sooner to useful size than when planted on the edge of a ditch; and therefore I now employ it chiefly. There is another and a very important advantage attending this mode of planting hedges without a ditch, which gives it great preference in an economical point of view, as compared with the other—namely, the taking up of very little ground in the subdividing of land; for it must be observed that where there is a hedge and ditch much useful land is occupied, but where there is no ditch the least possible quantity of land is taken up by the fence. In choosing or refusing the one or the other, much depends upon the circumstances to be overcome, which must all be taken into consideration. Upon several estates with which I have had to do, where most of the hedge fences had been reared upon the ditch system, I have put drain-tiles into the ditches and filled them up, in order to improve the fences, which had become stunted and unhealthy from neglect. By this many of these hedges, which were formerly in an unsatisfactory condition, are much improved, as they have been so much benefited by the additional supply of new soil about their roots; and, on the whole, this scheme promises to be of great advantage in the renewal of such old hedges as have been planted on the sides of ditches.

194. The cost of digging the ground and putting in the plants for the last-mentioned kind of hedge will be about 4d. per rood; and if we include the price of the plants also, the whole may cost about 10d. per rood. The

cost, however, will depend much upon the nature of the ground operated on, as, where the surface is very unlevel, and consequently there is much work to perform, it must cost proportionally more. I ought to state, therefore, that although on generally level land I have got such fences as have been described completed for the price named, still I have had many cases where the work cost 10d. per yard, and this difference arose from the difficulty in levelling the bed for the plants and making it dry.

195. In all cases of preparing soil for the reception of plants intended for a hedge, good earth should be added where it is naturally poor and bad upon the line, as, if this should not be attended to, the hedge will come away unequally—that is, strongly where the land is naturally strong and good, and weakly where it is poor and bad. Where it is found necessary to improve the natural ground on the line of a new hedge, this cannot be better accomplished than by carting fresh and good loam from a distance, and adding it in considerable quantities to the natural portion, and of course mixing them well together.

196. Lime is sometimes applied to the bed of a young hedge; and in moderate quantities on strong land, and on land having much vegetable matter in it, it has a good effect in causing the plants to grow quickly; but, further than this, no manure should be applied, as good fresh soil, applied with perhaps a mixture of lime, is always more conducive to the health of the plants than any species of vegetable manure.

197. I have found, from my more extended experience in the rearing of hedges, that the plants used should never be planted closer to one another in the line than ten inches, nor farther apart than twelve inches. I state this from finding that plants put in much closer than the former distance grow up weakly, and soon become matured, and that when put in at a greater distance than the latter, they are long in filling up so as to become a fence. I am of opinion, therefore, that from ten to twelve inches apart is a very suitable distance for plants growing healthily in a hedge, and for their becoming so strong as to resist cattle, which is the object in view.

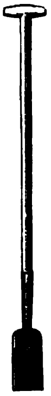
198. The best time of the year for planting hedges, whether thorn or beech, is the month of November, or that of February. In either case, the ground should be properly prepared some months previously, in order that it may have time to ameliorate and subside, as any subsiding should be made up before planting, otherwise the line will look badly.

199. We now come to speak of the after-management of the hedge-fence, which is a matter of the very greatest importance to the welfare of such fences, seeing that many of them die from the want of due care being bestowed upon them; and, as I have already said, the great points in their management are regular cutting and cleaning. Supposing that a young

hedge has been planted any time between the first of November and the end of February, it will during the following summer make considerable shoots. The thorns will, in all probability, have made shoots of nine inches at an average, but if beech plants are used, they will have made comparatively *little* progress, because they naturally require a longer period to establish themselves in the soil. If, however, they have appeared fresh in the leaf, and only made from two to three inches of young wood upon the top shoots, it is quite satisfactory; and indeed, had the thorn plant not been cut down, they very possibly would not have made a greater growth than the beech; and had the beech been cut down in the same manner as the thorns, it is very possible that the one half of them would have died. This explains the reason for cutting the one and not the other—that is, the growth of the thorn plant is encouraged by severe cutting, while that of the beech in its young state is the reverse, particularly as regards the old wood.

200. I am aware that many foresters are in the habit of cutting over in autumn the shoots of the first year in young thorn hedges; but to this practice I beg to object; because I have found, from observation and experience, that it is an error. I, in all cases of hedge-culture, allow the plants to remain uncut until they have two years' wood upon them, and until they have had their roots thoroughly established; and when they have arrived at this stage, I cut the plants over to about nine inches high, and dress in the sides also pretty closely, say in the month of November. During the first two summers, therefore, after the hedge has been first planted, all the attention necessary to be bestowed upon it is that of keeping it clear of weeds, which is simply done with a small spade, termed the hedge-cleaner (Fig. 6); this is about four feet in length, including the handle, and the spade itself is three and a half inches broad, by about seven inches long, excluding the hose, which is about the same length as the spade. This spade is kept pretty sharp upon the edge, and is wrought much in the same manner as a gardener does a Dutch hoe. The hedges should be cleaned twice in the season—namely, in the months of June and August.

FIG. 6.



201. Before entering farther into the management of hedges as a fence, it may be necessary for me here to explain the nature of my objection to not cutting over thorn hedges of one year's growth as many do. It is this: Having from experience found that a young hedge not cut the first season after planting is much superior two years afterwards to one that is cut in the usual way, I set myself to prove the matter upon practical principles. I therefore planted two pieces of hedge, and left the one cut, and the other uncut, during the following winter; and during the second summer I watched the progress of each

minutely: the hedge that was left uncut came away much earlier in the season than the one that was cut over; and during the summer I found the leaves and shoots of the uncut hedge much stronger and healthier in appearance than those of the cut one; and in the month of October, when the wood of both was fully ripened, upon comparing them together, I found the older shoots of the uncut plants decidedly superior to those that had been cut. From this I concluded that, when the shoots of the first year's growth are left upon the plants during the second year, they, from having a great surface of leaves and prepared young wood upon them, are enabled to carry on the vital functions more early and readily; consequently, much nourishment is drawn up from the soil, and a regular proportion of woody matter made in the plant; whereas, in the case of the cut plants, I considered that, in the early part of the second summer, when the uncut plants were expanding their leaves, and drawing nourishment both from the soil and air, the cut ones, from the want of young wood, had to make new leaves, and young wood also, before they could grow as rapidly as the others. But after the plants are two years old, and properly established in the soil, I have always found that they grow more vigorously from being well cut; therefore it is that I object to the cutting of thorns until they have their roots properly established, and that is after they have been two years in the soil.

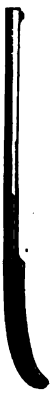
202. In the training up of a hedge, where the object is that of having a firm and compact fence, capable of resisting the ordinary efforts of cattle of any description, the only mode is that of keeping the ground immediately under the hedge plants clean from all weeds, as this secures the health of the hedge in the under part, and allows it to spread down to the very ground; whereas, when weeds are allowed to grow under the hedge, it soon becomes bare and naked of branches, and proves open and weak there. In the cleaning of hedge fences, it is also an object of great importance to keep the ground clear of weeds at least one foot beyond the *drip* on each side; for this secures a free current of air passing through, without which a hedge fence is sure to become bare and weakly below. This cleaning, once the ground has been a few years regularly kept, may be done for one halfpenny a rood per year throughout the whole period; but if the hedges have been allowed to become dirty from the want of attention, and if they have not been cleaned for several years, as is too often the case, they may cost four or five pence a rood to put them in order, even for one cleaning, besides the injury done to the fence. These observations I make here in order to point out the great necessity and propriety of keeping all hedge fences clean; for although it may indeed cost a proprietor a few pounds each year to do so, still, if the work be neglected for three or four years, a much larger

sum is eventually required to put them right, independent of in a great measure ruining his fences.

203. Having said this much as to keeping clean all hedge fences, I in the next place have to say, that in the training up of a hedge, where the object is that of having a firm and compact fence capable of resisting cattle, the great point is, after that of keeping clean, to cut the fence yearly according to a given form; and this form must in all cases be regulated by the situation in which the fence grows, by the object in view, and in a great measure by the taste of the proprietor. In order to illustrate my meaning more fully, I shall make a few remarks upon each of these points. I said that it is necessary to cut hedge fences yearly; and I believe that there are very few practical foresters who will not agree with me upon this point; for every one who has had his attention directed to the rearing of such fences, at once sees the difference between a hedge not cut yearly and one that is. In the first case, the hedge soon begins to get bare at bottom and over bushy at top; besides, it very soon becomes loose and open, and without firmness or compactness to resist as a fence ought to do. In the latter case, the hedge, from being regularly cut, is kept close in texture from bottom to top, and is healthy and long-lived as compared with one not regularly cut.

204. In cutting young hedges and training them up to maturity, I allow the plants to remain uncut till the end of the second year, when, for the first time, I cut them over about nine inches from the surface, and at the same time I cut in the sides pretty closely also, using for the purpose what is termed the hedger's switching-bill (see Fig. 7), and never the shears, as some do in cutting young hedges. The shears, in all cases where they are used for cutting a hedge, make a rough wound, which is generally attended with the loss of a bud or two under the wound; but the switching-bill, on the contrary, makes a clean cut, and no bad consequences follow. Besides, a hedge that is cut by using the bill is in all cases trained up more closely and firm than one cut with the shears. In cutting a hedge for the second time, which will be when it is three years old, I cut it down to about twelve inches in height, making it regular on the top level; and in the side cutting I leave only about one inch of a spur of the last year's growth. This I continue to do each year successively until I have the fence of full size; that is, in each successive cutting that I give a young thorn-hedge annually, I leave it four inches higher, and one broader on each side, than it was the previous year, until I have it four feet high, after which period I keep it down each following year as nearly to the old height as possible. For every forester must be aware that, in cutting hedges, they will increase in height and breadth of their own accord under the best sys-

Fig. 7.



tem of cutting, seeing that, in the act of cutting off the annual shoots, there is always a short piece left, called a spur, at the base of every young shoot cut. So much, indeed, does this increase the bulk of the best kept hedges, that in course of time it is found necessary to reduce them in bulk, and to allow them to come away anew again, which yet remains to be explained. A hedge, in the course of a number of years, however well kept, generally out-grows itself, from the cause above stated; and this state of a hedge is easily known by its becoming loose in habit, and of an open overgrown appearance. Now, there is no way of renewing a hedge in this state but that of cutting it in, or what is termed *ribbing;* and this ribbing consists in stripping the hedge of its side branches, and allowing it to make new wood all over. But in doing this caution must be used; for I have more than once seen, where hedges had been ribbed without due caution, that they died down to the surface, and consequently had to be cut over at that part, and allowed to grow up anew from the old roots. Therefore, in the ribbing of a hedge, the following points must be kept in view: When it is found necessary to *ribb* in a hedge, let it be considered whether or not the situation be an exposed one; and if the situation be not an exposed one, nor in a part of the country exposed to the sea, nor more than six hundred feet above the level of the sea, the ribbing may be done from November to the first of April, as may best suit. In doing the work, the operator will use what is termed the *ribbing-bill,* which is much stronger and heavier than the switching-bill, and has less hook upon the point. In ribbing the hedge, the operator cuts off all the lateral branches *upwards,* to within about four inches of the main stems upon each side; and the hedge over all should also be reduced in height to about three feet. It should also be kept in view, in the case of ribbing in a hedge, that if sheep or cattle are in the habit of grazing in the field adjoining, the ribbing should be done at a period when the field is under farm-crop, and when there is to be no stock grazing for a year or two after; for if it should be done at a period when sheep or other animals are in the field where the hedge is, they are sure to injure it by eating the young shoots as they grow; besides, their hair and grease are injurious to the welfare of a hedge so closely cut in. Again, where the situation of a hedge to be ribbed is much exposed, do not ribb it before the month of March or April, when any severe check from the effects of exposure is likely to be over for the season. From this rule not being observed, I have frequently seen hedges die down to the ground when they were ribbed in the winter season upon a high and exposed part.

205. Switching hedges is generally done for a halfpenny per rood, and ribbing for twopence—that is to say, when such work is contracted for by hedgers.

206. There is also the renewing of old and neglected hedge fences to be taken into consideration. It very often happens that where hedge fences have been badly managed for a few years successively, they begin to die out by degrees: this is evidenced by many of the plants becoming stunted in appearance, and by gaps occurring here and there from deaths among the plants, and the more healthy of them becoming tall and spreading. This state of hedges may be accounted for in various ways: it may be caused by neglect of thorough drainage, and by neglect of keeping the plants clear of weeds; it may also be brought on from the natural soil not being well adapted to the healthy growth of the plants, and also from neglect of properly cutting the plants, and by allowing them to grow to such an extent as to exhaust the ground. In order to renew such a neglected hedge as has been described above, the plants require to be all cut down to within about six inches of the ground, observing to make the cuts upwards. When this is done, and the rubbish removed, the ground should be well cleaned, and dug to the extent of about twenty-four inches upon each side of the hedge-line, and all gaps among the old stumps made up with new or young plants. In making up with young plants among the roots of old thorns, I have to observe that young plants of the same sort should not be used in such cases, as they never succeed well where old thorns have been growing; but in all cases of this nature use beech plants, for they thrive well among old thorns. Work of this kind may be done during fresh weather any time during winter; and in order to have the hedge continue sound and prove a good fence afterwards, it must be kept clean, protected, and regularly cut, as has been already stated. The directions just given for the renewal of old and neglected hedges will be found to answer very well where the subjects are comparatively healthy, and not too far destroyed by disease; but with regard to such old hedges as have been very much neglected, and are in consequence very much diseased, the mode I have recommended will not recover the plants so as to cause them to grow healthily and make a fence. Where, therefore, the plants forming a hedge are very much diseased from one or other of the causes stated, they should be dug out altogether, and a new hedge planted instead, and upon a new line of land, if possible, as to replant upon the old line, where the soil is exhausted, would be very injudicious. If, however, it should be found necessary to plant again upon the old line, the land must be rendered perfectly dry by drainage, if at all wet; afterwards the exhausted soil of the old line must be entirely removed, to the extent of five feet broad and two feet deep. Into this, good soil should be put from an adjoining field, and the young hedge planted in it in the usual way. No other mode will secure a thriving fence under such circumstances.

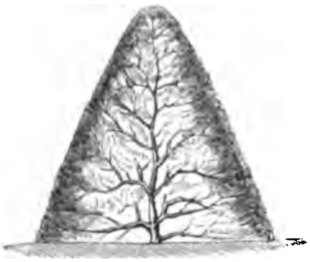
207. We now come to consider the form in which hedge fences should be trained up; and, as I have already said, this form must be regulated by the situation in which the fence grows, by the object in view, and in a great measure by the taste of the proprietor.

208. There are four forms of hedge fences as generally adopted in different districts of Britain; namely, the wedge-shaped, the full-sided, the square-shaped, and the upright. The form of each of these will be better understood by referring to Figs. 8, 9, 10, and 11, which represent an end section of each of the four different forms mentioned.

A few remarks upon each of these forms of hedges will be enough under the present head.

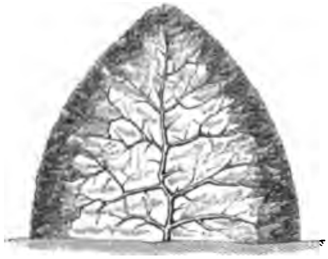
209. The wedge-shaped thorn hedge, an end section of which is represented by Fig. 8, is of all others the best form for a high-lying district where snow is apt to prevail; and it is, moreover, the form which is by far the simplest to keep in order in the way of cutting. In high-lying parts of the country, hedges are often much injured by heavy falls of snow resting upon them; and in a case of this nature the wedge form is the best that can be adopted, seeing that much perpendicular pressure cannot lie upon any part of it. It is this shape of a hedge that we have upon all the high-lying agricultural districts of both England and Scotland.

FIG. 8.



210. The full-sided thorn hedge, an end section of which is represented by Fig. 9, is the most common form to be found in all well-sheltered agricultural districts, for which it is very well adapted; for, by its bulging sides, it is not easily approached too close or injured by stock of any kind; but it is very apt to go out of order, and to overgrow itself, if not under skilful and good management. Excellent specimens of this form of hedge are to be seen in the Lothians of Scotland, and in the best cultivated districts of the central counties of England, where the soil is well adapted for its healthy development. It is not, however, adapted for a high-lying country where snow is apt to prevail, for its bulging sides are very apt to be crushed and broken by the weight of snow lying upon it; and this I have had frequent proof of in many high-lying parts of Scotland.

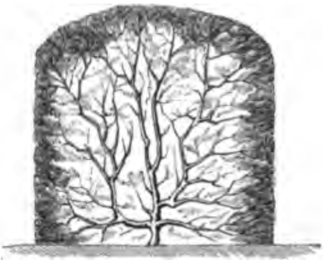
FIG. 9.



211. The square-shaped hedge, an end section of which is represented

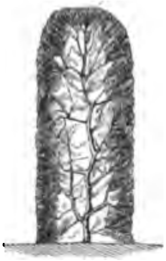
by Fig. 10, is solely adapted for gentlemen's home or policy grounds, and ought never to be introduced either as a wood or a field fence; and I merely advert to it in order to point out its impropriety for general use. It is all very well to have a fence of this kind round a garden, where it may be well kept; but as a general country fence, it is the most liable of all to become overgrown and useless.

FIG. 10.



212. The upright hedge (Fig. 11) is an admirable fence, and is well adapted for pleasure-ground scenery, or about home parks, but not at all for a farm or field fence. Now I think it is plain, from what I have said, that, in choosing the form of a hedge, it is always of the first importance to consult what is most useful rather than that which is most ornamental. It would be foolish to rear up a hedge in the square form upon a high-lying district, merely for the sake of gratifying the taste, when it is well known that such a form would not answer. In short, such a state of things would be bad taste; yet it is very often to be observed. For my own part, I consider the wedge-shaped and the full-sided forms the best that can be adopted for usefulness; and the other two I consider merely as ornamental forms, but well adapted for the producing of extra shelter upon home grounds.

FIG. 11.

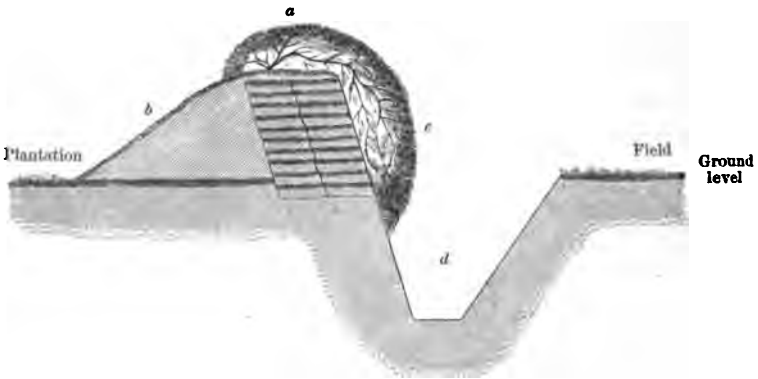


213. *The whin or furze hedge* (*Ulex Europæa*) is one which prevails much in many parts of the north of Scotland as a plantation fence; but it does not, in my opinion, make a fence worthy of being recommended, seeing that the whin is extremely apt to be injured by a winter of severe frost; and, in their best condition, the whin hedges form such harbours for rabbits that they are extremely objectionable as a fence for young plantations. I do not know of any case in which whin hedges have been planted where a properly-managed hedge of beech would not do much better in every sense of the word, it being longer lived and more ornamental.

I am aware that in many parts of the north of Scotland where whin hedges are, it is considered that any other sort of hedge would not thrive, nor make a useful fence nearly so well. But as to this I am decidedly of an opposite opinion; for in many parts of the north of Scotland, not more than four hundred feet above the level of the sea, whin hedges may be found in abundance, forming miserable, half-dead looking fences, where, if beech had been planted instead, a permanent, good-looking fence would no doubt have been reared.

By referring to Fig. 12 the method of rearing whin hedges, as generally practised in the north of Scotland, will be easily understood: *d* is an

FIG. 12.



open ditch, about four feet wide at top, and sloped in to about one foot wide at bottom. It will also be observed, that the slope of the ditch upon the field side is more flat than that of the plantation side, and this is in order to make the plantation side of the ditch act better as a fence. The ditch is made about three feet deep from the ground level, and the turf, as taken from the surface of the ground in making the ditch, is built upon the plantation side to about the height of other two feet above the surface, making the fence altogether, from the bottom of the ditch, five feet high. In order to make the turf-built part of the fence secure, it is made about two feet thick, with the same slope backwards as the side of the ditch under, and founded firmly upon the surface. The earth, as taken from the ditch, is banked firmly behind and a little over the top of the turf, in order to form a bed for the sowing of the whins, as at *b*. The whole being finished, the seed of the whins is sown in a line along the top of the bank, as at *a*, about eighteen inches back from the upper edge of the fence.

When the young plants appear above ground, the seed being sown in April, they are kept clean during the first and second years, and thinned when too thick; and the third summer, when they have become pretty strong, they receive a dressing with the switching-bill. In doing this, they are cut in the direction of the field—that is to say, the bill is entered at the back or plantation side of the whins, and brought forward, cutting towards the ditch, or downwards; and by this means the young shoots are made to grow out in that direction, presenting all their points to the field, and consequently forming the best position for a fence. Whin hedges ought never to be cut at any time of the year but when they have newly shed their flowers, which is about the middle of June; for it is then that they form their young wood, and are consequently most improved by cutting. I have seen many whin hedges die from being cut in spring or autumn; consequently they ought never to be cut but in the beginning of their growing season. In the training of whin hedges, they are made to lie over the slope, as at *c*, and not allowed to spread much back into the wood. The best fences of this description that I have seen are upon the Earl of Fife's estates in Aberdeenshire.

214. THE HOLLY HEDGE—that is, the hedge formed of the common holly (*Ilex aquifolium*)—makes an excellent and ornamental fence, where only required as a screen to hide some part of the grounds from view, or where shelter alone is wanted; but from the nature of the plant is not adapted to form a strong fence against cattle in fields. One advantage of the holly is, that it grows well under the shade of trees, and from this it is fitted to make a hedge on many situations where few other plants would succeed. To grow it well, however, it requires to be planted in a good, dry, light loam, having an abundance of vegetable matter in it. I have never yet found the holly succeed luxuriantly in a soil destitute of a large amount of old and well-decomposed vegetable matter, such as a sandy moss or a soil chiefly composed of well-rotted leaf-mould. In planting a hedge of this plant, therefore, this should be kept in view; as, if not, failure will be the result.

215. THE COMMON PORTUGAL LAUREL (*Cerasus lusitanica*) makes also a very ornamental evergreen hedge, but is suitable in this respect only in such situations as are not exposed, as in the neighbourhood of large trees. Being a native of the continent of Europe, it does not thrive without shelter, and is therefore not adapted to make a fence in fields. It is, however, not particular as to soil, but seems to accommodate itself to most soils, provided it be sheltered from cutting winds.

216. THE COMMON YEW-TREE (*Taxus baccata*) is also well suited for ornamental hedging, but, other than this, it is worthless, not only on account of its naturally slow growth, but also because its habit is of too soft a character to resist large animals. Another objection to its being grown where cattle graze is, that its leaves are believed to be poisonous to them. I have myself seen sheep die from eating the leaves and young shoots of this plant.

217. THE BOX-TREE (*Buxus sempervirens*) is another plant well adapted to ornamental hedging, but is of no advantage for field or other fences.

218. THE PRIVET (*Ligustrum vulgare*) is a plant of rapid growth, and well suited in some respects for hedging. It is not a plant suited to make a strong fence as a hedge of itself, as it is not only of too soft and pliable a nature to resist pressure, but it is also of such a free and rambling growth, that it is very difficult to keep it in any degree of tidiness or shape. I like this plant very well, however, for the purpose of filling up gaps in old

hedges of thorn, in which it is sometimes very difficult to get any other plant to grow, so as to fill up a spot where an old thorn plant had died. I recommend the privet, therefore, for this purpose. In using them, it is only necessary to dig out the old roots of the dead thorn plants, and insert young ones of the privet instead, say at six inches apart. I have seen small gaps in old hedges excellently repaired in this way, and as the naturally rapid growth of the privet is promoted by the shelter and support of the old hedge, gaps may be filled up by it, in a complete way, even in two years after planting.

219. BERBERRY (*Berberis vulgaris*) is another plant frequently used for hedging, but as it is very apt to die under severe pruning, as is indispensable in hedge culture, it does not generally answer well.

220. HORNBEAM (*Carpinus betulus*) is a plant well suited to hedging. Indeed, in this respect, it is only surpassed by the thorn and the beech, among all the hedge plants we have. I have seen excellent hedges of this plant on a light sandy soil, on which thorns would not succeed. The plant attains a third-rate tree size, and therefore forms a strong and permanent fence as a hedge, when dealt with in the common way.

221. THE BIRCH (*Betula alba*) is well suited for hedging on poor thin soils having a high altitude. It stands pruning well, and when properly trained and kept in, it makes a fair and permanent fence.

222. THE ELDER (*Sambucus nigra*) is much used for hedging in the north of Scotland, but its hardiness and quick growth are its only recommendative qualities, as it is ill adapted to produce shelter in winter and spring. I am of opinion that, as a hedge plant, even for high and exposed situations with a poor soil, the beech and the birch are much preferable to the elder. When a screen is quickly wanted, however, on an exposed part, it is certainly preferable to any plant we have for the purpose, as it will generally make growth of from four to six feet in one season.

223. In rearing hedges from the plants referred to under the nine paragraphs immediately preceding this one, they should have the land prepared for them in the way recommended for the cultivation of the thorn and beech hedges, and in planting them in the lines, no pruning should be allowed on the holly, the Portugal laurel, the yew-tree, the box-tree, the berberry, the hornbeam, and the birch. They should also be allowed to stand uncut for a period of two years after planting, and until they shall have become properly established in the soil, when they may be dealt with in the usual way. But plants of the privet and elder, when used for hedging, should be cut over at first in the way recommended in respect to the thorn, and should also be pruned well in every year afterwards.

224. In the cultivation of all hedge fences, as little digging should be

allowed as possible, as the operation invariably disturbs and destroys the roots, and where the roots are destroyed by such injudicious management as the practice of frequent digging is, the hedge plants become of weakly constitution, gradually lose their vitality, and consequently die. The only digging I should allow in the management of hedges would be in the case of such as had to be cut over, and such as had been neglected in cleaning for some years. In such cases, digging in order to attain cleanness is indispensable. Where hedges are well kept, it is never found necessary to *dig*, but to hoe only.

225. Hedges formed of *deciduous* plants should never be pruned till the young shoots of the season are matured, as, if they should be cut before this, the plants suffer in health in consequence. This point is generally too little attended to, and hence one of the causes of disease in regard to a very large extent of the hedges of this country. In the economy of a plant, the roots draw up food from the soil, and the leaves prepare it for the healthy growth of all its parts. If this is the case, then, and it is admitted to be so by all physiologists, how can deciduous hedges grow healthily that are annually dug instead of cleaned, and switched in summer, while their young shoots are only being developed? I condemn, in the strongest possible terms, all such management of this class of hedges, and recommend, instead of such barbarous operations, to use the hoe only in cleaning, as a proper use of it will not injure the roots of hedge plants, and that no switching or pruning should be done till after the leaves shall have performed their functions in the economy of the plant, and this may at any time be known by the leaves falling off, as at this stage it is evident they have ceased to be of use to the plant.

226. The pruning of hedges formed from evergreen plants, I am of opinion, should be done just when they begin to grow. This may, of course, vary with the nature of the season, and with the respective kind of plant of which the hedge may be formed; but I think that I am safe in stating that, generally speaking, the month of April may be taken as a safe time for the pruning of all evergreens.

227. If hedges are well attended to while young, they are not so expensive to maintain afterwards as many imagine. It is neglect that principally gives rise to expense in connection with them. On well managed estates in Scotland, I have had hedges, well kept ones, cleaned and pruned, and in every respect kept in good order, for one farthing per yard per annum, or at the rate of £1, 16s. 8d. per mile: this certainly cannot be considered expensive. But, on the other hand, I have to add, that on other estates, where the hedges have been in bad keeping for some time previously, they have cost the proprietor nearly ten times this sum.

SECTION V.—THE BUILDING OF STONE AND LIME WALLS AS APPLIED TO MAKING SUNK FENCES.

228. The building of stone and lime walls is, properly speaking, more a part of masonry than of forestry; but it must be admitted that foresters and land-stewards, who have to superintend country business generally, are often called upon by their employers to give an estimate of the expenses of buildings of this nature. And more especially as I have frequently to produce estimates of masonry in so far as it is applied to fencing, it is more than likely that other foresters may have to do the same; and it is for this reason that I advert to it.

229. Stone and lime walls are most frequently built for the purpose of policy-fences, or for sunk fences. As to the erecting of walls for the protecting of home or policy grounds, the dimensions of such must in all cases be regulated by the views of the proprietor—that is, if the proprietor merely wish to have a wall erected in order to protect his home grounds from the inroads of cattle, it may be built sixteen inches thick at bottom, twelve inches at top immediately under the cope; the cope may be ten inches high, pick dressed, and project two inches over the building on each side; and the whole height of the wall may be made, including the cope, five and a half feet. A stone and lime wall of these dimensions may in general be got done for 2s. 9d. per lineal yard, calculating that the stones have to be quarried and carted a distance of about a mile.

230. If the proprietor wish to have a stone and lime wall erected, sufficient to protect from the inroads of people who may be apt to transgress in the neighbourhood, as well as to retain deer that may be kept in the home parks, he would require to build it at least about seven feet high; and a wall of this height would require to be eighteen inches thick at bottom, and fifteen inches at top of building immediately under the cope, which would require to be at least twelve inches high. A wall of such dimensions may in general cases be got done for about 4s. 9d. per lineal yard, including carting of stones as above. A great point to attend to in the building of stone walls for fences is, to see that no soft or bad stones be used, particularly in the outer part of the building; for if such be used, the wall is sure not to last long, nor give anything like permanent satisfaction; therefore, the forester or land-steward who may be intrusted with the inspection of such work, should be most careful to see that this point is enforced upon the contractor. There is another point to be observed in the erecting of all stone walls, whether these may be built with lime or not; and that is, to see that all the stones used in the building be laid upon what is generally

termed their natural bed; that is, the natural seams in the stones should lie horizontally in the building, and not vertically.

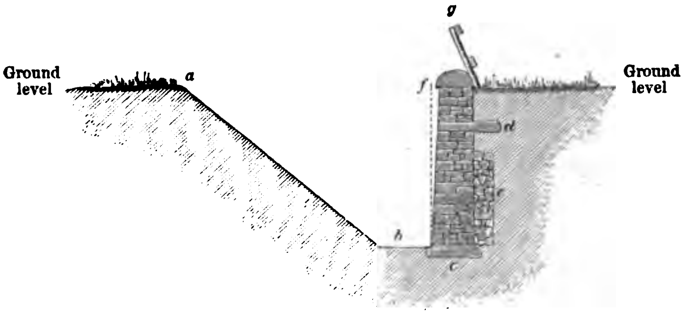
231. Having said this much as to the building of stone and lime walls as they are generally applied to the fencing of policy grounds, I now come to treat of them as they are generally applied in the making of *sunk fences.* But previous to giving directions as to the manner of doing this sort of work, I will say a little as to the propriety or impropriety of making sunk fences.

The sunk fence is one which, from its very name, is meant to be hidden. It is a fence often to be met with upon noblemen's and gentlemen's estates of old standing, and was a hundred years ago very much introduced in the laying out of grounds and home parks; but now since wire fences have come to be so much used, the erecting of sunk fences is fast giving way, and they are very seldom introduced; excepting, indeed, where they may answer some particular purpose, as on the slope of a hill or brae, for which situation the sunk fence is admirably adapted, and is of all others the most fit and suitable. No doubt, "taste is everything;" but, in my opinion, in the matter of fencing, that taste is always the most pleasing to all parties which can produce something light and airy, and of the most natural appearance, and at the same time at the least amount of expense. Now, in applying this to the erecting of sunk fences near or about home parks—where, indeed, taste should always be taken into consideration—we at once see that a sunk fence is, in regard to lightness, airy and natural appearance, much inferior to the wire fence, and is, at the same time, much more expensive in the first erection; therefore, in my opinion, sunk fences ought never to be made upon any level piece of ground, but instead, the wire-fence should be erected. But upon any steep sloping bank, where it is desirable to have a fence, I would recommend the sunk fence, with a low wire fence on the top, as a complete and answerable thing. As I am aware that many proprietors are much in favour of sunk fences as generally made, I shall here, in order to assist superintendents of such work, give a detail of the manner of erecting them.

There are two sorts of sunk fences—namely, the angular and the trapezoid. The angular is made with a wall upon one side and a paling fence upon the top; and the trapezoid is made without any wall, but having a paling fence in the centre. The construction of these will be better understood by referring to the following Figures.

Fig. 13 is an end section of an angular sunk fence, as often met with in the home grounds of old seats. The distance from *a* to *f* is generally eight feet, being the surface of the opening or ditch; the height of the wall, including the cope, from *f* to *b*, is generally about five feet six inches; and the breadth of the ditch at *b*, being the bottom, is generally from eighteen to twenty-four inches. But in the act of excavating a sunk fence of this description it is always necessary to calculate upon the thickness of the wall—that is to say, if it be required to make the sunk fence eighteen inches wide at bottom and eight feet wide at top when finished, and if the wall is to be eighteen inches thick, it will be necessary to make the opening at least three feet wide at bottom in the first place, and nine and a half wide at top. In building the wall upon a sunk fence, it ought to be founded upon large flat stones, laid upon their natural bed, as at *c*; and these ought to extend at least three inches wider than the bottom of the wall. The wall ought to be at least sixteen inches broad at bottom, and thirteen at top immediately under the cope; the cope-stones ought to project two inches over the wall upon the ditch side; and the wall should be built of the best stones in the neighbourhood, and well-prepared lime. The cope-stone should always be above the surface of the ground, as shown at *f* in the Figure. I have frequently observed sunk fences of this description tumbling down at a very early period after being built: this was occasioned by the damp ground behind the wall not allowing the lime to adhere to the stones—the wall, as it were, being always kept in a moist state. In order to prevent this effectually, a space of about eight inches wide should be filled up with dry stones immediately upon the back of the wall, about three feet high from the bottom, as represented at *e* in the Figure. This acts as a drain for the conducting away of the water; and, consequently, the building is kept dry and good. In order to carry off the water from behind the wall into the ditch *b*, holes about three inches wide by six inches deep may be left at convenient distances all along the bottom of the wall; and these holes should go right through the thickness of the wall at bottom, and should communicate with the drain behind.

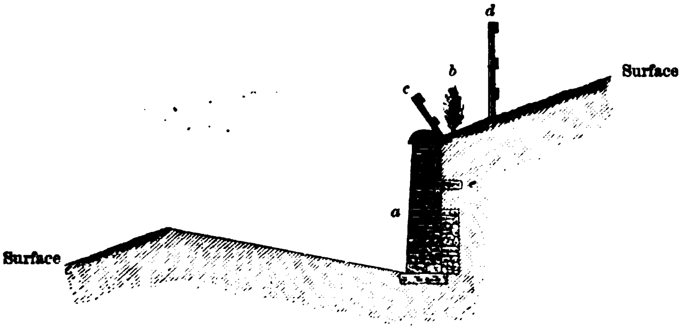
Fig. 13.



In order to make the fence more effectual for the field upon the side of which the wall is built, a low paling ought to be erected immediately behind the cope, and made to project over the top of the wall, as seen at *g* in the Figure; it need not be more than two feet high, and may be either made of wood or iron, as may be found most expedient. Many have a hedge planted upon the top where the paling is shown in the Figure, which is indeed a great improvement where shelter is wanted upon a high part; but this is not generally necessary with sunk fences upon level ground—where indeed they are not meant to be seen—but only upon slopes where the situation is an exposed one. Fig. 14 will explain the nature of the sunk fence with a hedge, as it is adapted for a high unlevel part, where immediate shelter is found of the greatest importance.

232. I consider the sunk fence, as represented in Fig. 14, to be one excellently adapted for a high-lying county, upon the slopes of rising and unequal ground. The wall *a*, which is four feet high with cope, may be very properly built of stones, without the addition of any lime if thought necessary, excepting the cope, which should in all cases be put on with lime; and in such a case the wall need not be more than fourteen inches through at bottom and ten inches at top; and if the wall be built without lime, it will not be necessary to make a drain behind, as formerly advised, seeing that the water can perfectly well escape without it. The hedge *b* should be planted about sixteen inches back from the top of the wall. In order to protect the hedge while in its young state from cattle upon either side, it is necessary to have a two-barred paling, *c*, upon the ditch side of the hedge, and a three-barred one, *d*, upon the upper side. There are some of these sunk fences upon the high farms on the estate of Arniston, which answer the purpose excellently, few fences being better adapted for a hilly country—that is to say, where the line of fence runs at right angles with the slope of the ground. In the first instance there is shelter produced for stock by the wall itself, which is yearly increased as the hedge grows; and

FIG. 14.



ultimately, when the hedge has arrived at perfection, a clothed appearance is produced, which gives a very pleasing effect.

I may further state relative to the building of sunk-fence walls, that it adds much to their strength to have them secured by what are termed through-band stones, as shown in Fig. 13 at *d*, and in Fig. 14 at *e*. These through-band stones should be put on about two-thirds of the height of the wall, with at least one to every six feet in length, and should consist of large flat stones about three inches thick, and of a length sufficient to reach from the front of the wall to at least one foot into the solid earth behind, into which they should be firmly bedded, in order to prevent the weight of the bank, if it should give way above, from pressing forward the building. Another point to attend to in the building of sunk fences, and which adds much to the strength of the whole, is, instead of building the front of the wall perpendicularly, to make it lie back about three inches at the top; or, as masons term it, "the top should be three inches backwards off the plumb:" this is indicated by the dotted line in Fig. 13, which shows the true perpendicularity—the wall standing three inches back from it at top.

233. We now come to speak of the cost of erecting sunk fences with walls; and the undernoted calculation will show this, as it is taken from my own note-book, containing an account of work of the same nature per lineal yard :—

Cost of erecting a Sunk Fence, as shown in Fig. 13.

To excavating and removing earth 100 yards distant—say 3 cubic yards, at 6d. per yard,	£0	1	6
... quarrying 2 carts stones, at 3d. per cart,	0	0	6
... cartage of do. one mile, at 1s. per cart,	0	2	0
... building one yard in length, including lime,	0	1	4
... laying turf on the slope,	0	0	3
... wood-paling on top,	0	0	3
	£0	5	10

Cost of erecting a Sunk Fence, as shown in Fig. 14.

To excavating and removing earth 100 yards distant—say 2 cubic yards, at 4d. per yard,	£0	0	8
... quarrying and carting stones one mile,	0	1	3
... building one yard in length, including lime for cope only,	0	0	5
... laying turf on the slope,	0	0	1
... putting up double paling,	0	0	7
... digging ground and planting hedge, including plants for same,	0	0	3
	£0	3	3

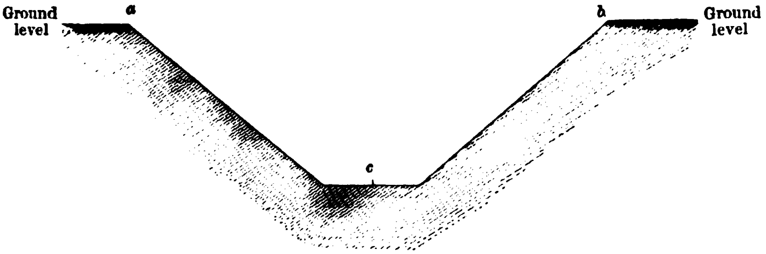
In giving the above estimates, I beg to be understood that, in many cases where materials are easily attainable, the work may be got done for much less money.

234. The *trapezoid* sunk fence, as I formerly mentioned, is made without any wall, having a paling in the centre. It is not so generally in use as the angular sorts which I have already described, being only introduced into low marshy parts of the country, where walls cannot well be had on account of the want of stones; and in such districts it answers a double purpose—namely, that of an outlet for the carrying away of water from the adjoining fields, as well as forming a fence.

The construction of the trapezoid sunk fence will be understood from the undernoted figure, which is an end section of the same.

These fences are generally made fifteen feet wide at top, as from *a* to *b*; five feet deep and three feet wide at bottom; and are in most cases excavated at the rate of 8d. per cubic yard—removing the earth to the distance of one hundred yards. A paling is generally erected along the bottom of the sunk fence, as at *c*, in order to keep back cattle from either side; and when the slopes are finished and properly levelled, the turf from the top should be laid down upon the sides again. When this is insufficient, both sides should be turfed from bottom to top, by carting it from a distance; because, if not turfed, the slopes are very apt to crumble down into the water-course, and set the water to work in undermining the sides. Besides, where cattle are to be pastured upon either side, it is absolutely necessary to have it laid with turf. Work of this description ought to be done in the spring, or at least in the early part of summer, so as to have the turf growing and bound to the soil before the floods of autumn set in.

FIG. 15.



Fences of this description are not now much in use, being old-fashioned, and, in my opinion, unsightly. However, as there are many of them both in England and Scotland, particularly in the flat-lying mossy districts, I have considered it but right to advert to the making of them. I have even assisted in the making of such a fence myself in the Lowlands of Scotland, particularly in Fifeshire, in wet undrained districts, where it answers well both as a fence and an outlet for superfluous water; but in high-lying, drained, or well-improved districts, it is a fence of no importance.

SECTION VI.—THE BUILDING OF DRY STONE DYKES WITH LIME ON COPE ONLY.

235. The most extensively used fence in the high inland districts of Scotland and the north of England is the dry stone dyke. From the nature of the country in those high districts, stones are plentiful, and of course easily attainable; from which circumstance it is a fence much in use for all purposes. Stone dykes have the effect of affording considerable shelter both to young plantations and agricultural cropping as soon as they are erected for that purpose; and are also of great importance in high countries, as giving immediate shelter to cattle in the adjoining fields, which is a great point in favour of their extensive use. This, of course, is not the case with a young hedge fence, which requires from nine to twelve years to produce efficient shelter.

236. The dry stone dyke used to be built entirely without the addition of any lime or mortar to bind it, and consequently it was always apt to be broken down by cattle or any other strong pressure coming in contact with it; but within twenty years past a great improvement has been effected in the building of them, by having the top or cope stones all put on and bedded in lime, which keeps the dyke altogether in a more firm and compact state than that built upon the old principle of having no lime upon any part of the dyke.

237. Dry stone dykes are built of various heights, from four to six feet; but the most approved height for general purposes may be said to be five feet over all. In giving directions as to the proper manner of executing the work of building dry stone dykes, I shall here give what are termed *Specifications* for building dykes of the description mentioned; and as they are of the most approved sort for work of this kind, such a copy of specifications may no doubt prove useful to foresters and land-stewards in general who may have occasion to superintend such work. The following is a copy of the specifications which I use in erecting any dykes I have the management of:—

MINUTE of AGREEMENT between A. B. on the one part, and T. P., residing at S——, on the other part—for erecting a March Fence between the farm of Y—— and the farm of O——, upon the estate of A——.

First,—The stone dyke to be erected under the present agreement is on that part of the line of march beginning at the present shepherd's house, and from said shepherd's house to the extreme summit of the hill.

Second,—The said dyke shall be built according to the following specifications:—
The dyke is to be five feet high. The foundation must be laid with large flat stones, which foundation must not be less than thirty-four inches over. The setting off of building upon the said foundation must be twenty-eight inches, leaving a scarcement of three inches upon each side. At twenty-seven inches in height, the dyke to have a row of through-band stones, six at least to the rood of eighteen feet. The dyke to be built forty-five inches of double, and the cope and coble to stand fifteen inches. The coble stones to project at least two inches over the doubles. The cope and coble to be properly bedded, built, and pointed with lime, which must be mixed with the regular and proper quantity of sand. The whole to be finished in a sufficient and workman-like manner, to the satisfaction of A. B., who is appointed inspector of the work.

Third,—The said T. P. binds and obliges himself to execute the whole of the work, in terms of the above specifications, at the price of *twelve shillings* per rood of eighteen feet lineal measure, and to complete the same before the first day of   next, but with power to the inspector above named to extend the time for building as he may see proper and right.

Fourth,—The said T. P. further binds himself to uphold the said dyke for three years from the time that the work is finished, and at the expiry of that period to deliver it over to the proprietor in a proper state, and to the satisfaction of the said inspector, or any qualified person who may be appointed by the proprietor.

Fifth,—The whole of the stones used in building the dyke must be of good quality, and approved of by the inspector above named. And no crop of rock or wasting stones shall be used; and the contractor shall pay the tenants of Y—— or O—— for any damage they may sustain from quarrying or driving the stones through their fields or over their grass lands.

Sixth,—The contractor, on receiving full payment of the price, shall either find good security for implement of the contract, or leave in the hands of the proprietor the sum of sixpence per rood for the said period of three years. In witness whereof, these presents, written by A. B., are subscribed by the said A. B. at A——, the twenty-third day of May, in the year eighteen hundred and forty-eight, before these witnesses, P. S., W. M., and R. S.; and by the said T. P., at S——, upon the day last mentioned, before these witnesses, J. P. and A. H.

P. S., *Witness.* A. B.
W. M., *Witness.*
R. S., *Witness.*
J. P., *Witness.* T. P.
A. H., *Witness.*

238. Having given the above form of specification for the erecting of stone dykes, I consider it superfluous to add more upon that point, as any intelligent man may, from consulting the same, be perfectly qualified to take charge of such work. A dyker is, properly speaking, a business separate from that of a forester. No forester or land-steward can be expected to be an adept in building stone dykes himself: all that is required on their

part is to know how the work ought to be conducted upon right principles, and to be so far a practical judge of the matter as to detect what is wrong from what is right as the work proceeds. There are dykers enough in most districts where such fences are in general use who can be got to do the work at a fair rate ; and all that is required of the inspector is to see and to be able to know how the work should be done. I may, however, here state, that in building stone dykes the inspector should examine minutely, as the work goes on, if the same be well built together; that is, he must see that no open spaces be left in the body of the dyke, which should in all cases be firmly packed with the smaller stones; and the method which I take, when suspicious in this matter, is to give the dyke a stroke with my foot about half height on the one side, and if opposite to this part where I strike the dyke it come out a little, just in proportion to the stroke given, as may be observed by another person on the opposite side, the dyke may be considered *well packed ;* but if the stroke of the foot does not tell upon the opposite side, and cannot be observed by the eye, it is certain that the dyke is hollow within, there being no due solidity throughout so as to cause one stone to press upon another from side to side when the stroke is given. The inspector ought also to see that all the stones used are put or laid on their natural bed, and that every individual stone rests upon two lying under it, and never upon one.

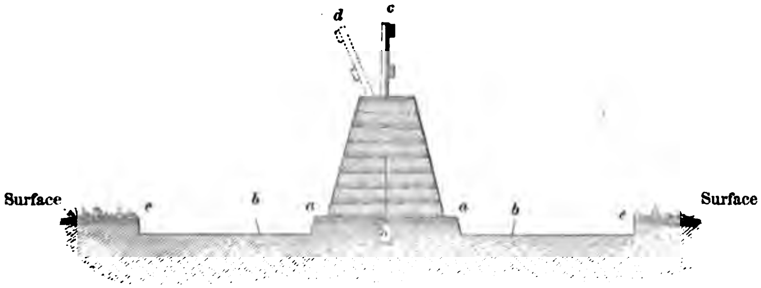
239. The cost of erecting stone dykes differs in different parts of the country, that depending entirely on the price of labour in the neighbourhood where the dyke is to be erected, as well as upon the convenience of getting stones for the purpose. If stones are to be carted far for the line of fence, the expense becomes considerable; but the stones being laid down, it is generally got done for three shillings and ninepence per rood of six yards, including the cope and coble well put on with lime. In Mid-Lothian I have seen dykes put up for five shillings per rood, including every item of expense; and in this case the stones were plenty in the adjoining fields, consequently the cartage was easily executed. In other instances, where the stones were difficult to quarry, and where the stance of the dyke was about a mile from the quarry, I have seen fourteen shillings per rood paid; therefore, in calculating the expense of erecting dry stone dykes, the distance of cartage for the stones is the most material point of consideration. A dyke five feet high, such as is specified above, requires about ten cart-loads of stones to the rood ; and when the quarry is opened, and the nature of the stones observed, it will not be a difficult matter to calculate the quarrying, cartage, and building in any particular district.

SECTION VII.—THE BUILDING OF TURF DYKES WITH PALING ON TOP.

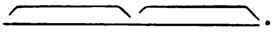
240. In many high-lying parts of the country, where stones are not easily got at, and where, upon account of the nature of the soil, it would not be advisable to plant hedges, a very neat and answerable fence is often put up for the purpose of enclosing both young plantations and agricultural fields, termed the *turf dyke*.

The nature and dimensions of turf dykes, as I generally build them, on comparatively level parts of the country, will be at once understood by referring to Fig. 16, which is an end section of a turf dyke; and as they are not, like stone dykes, built by a class of men making such work their business, but must be built entirely under the eye of the forester or land-steward, I shall enter rather minutely into detail of the method of erecting them, so that any intelligent man, from consulting the Figure and directions herein given, may be enabled to erect them anywhere.

FIG. 16.



241. The line for the erecting of a turf dyke being laid off by a set of pins running along the tract of the ground upon which the fence is to be, the operator, in beginning the work of building, first measures eighteen inches from the centre of the line of fence as at *o*, to one side as at *a*, where he fixes the end of his line into the ground, and, stretching it along the run of fence as far as his line will reach, he fixes the other end of it eighteen inches from the centre, in the same manner as at the end where he first started, and of course upon the same side of the fence; and having his line tightly stretched and *pinned* exactly eighteen inches from the centre at any given point, he next proceeds to edge off with a spade the whole length of the line, in order to form one side of the foundation-stance of the dyke. In edging off the side of the stance along the line as has been stated, the operator must cut the surface or turf, standing with his face to the field and his feet upon the foundation part of the intended dyke, and this in order that

the edge of the stance, as at *a*, may be cut with a considerable slope outwards, as shown in the Figure at *a*, upon each side. This sloping of the edge of the stance or foundation is meant to answer a two-fold purpose, namely—the turf when cut from the ground with a slope, when laid on in the building of the dyke, corresponds with its sloping upwards; and the edge of the stance, when finished in a sloping manner, lasts much longer than it could do if it were cut perpendicularly. In the same manner the other side of the stance should be cut or edged; measuring also the other side eighteeen inches from the centre to the opposite side, making the foundation three feet wide over all, as seen from *a* to *a*. The foundation having been marked off as has been directed, the operator next proceeds to measure outwards from the edge of it, as from *a* to *b*, upon each side, a turf fifteen inches broad at top; and placing his line to the same measurements, he edges off with his spade—which should be an old half-worn one, kept pretty sharp—a line of turf fifteen inches broad, the whole length of his first line on each side of the stance; and it must be observed here that, in edging off these turfs upon each side, the operator must cut them with his face to the stance of the dyke, in order to make the outer edges of the turf slope contrary to the inner edges, as shown in the Figure at *b b;* consequently, the two turfs, when cut and turned upside down and laid along the side of each other upon the foundation, will appear thus . This answers a twofold purpose as the work proceeds—namely, the turfs are at once prepared to answer the sloping of the dyke as it progresses upwards; and as the turfs, in the case of joining them in the centre of the building, are much improved by having a portion of earth put between the seams, this can at once be done by filling up the opening caused by the contrary slopes meeting in the centre, which opening is at once readily filled from paring the bottoms of the turfs when lying as turned up out of the earth, and levelling them for another layer of turf coming above progressively.

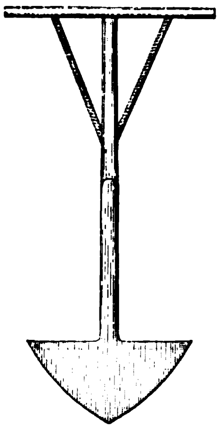


Fig. 17.

The two lines of turf being formed by edging them off with an old sharp spade, as directed above, a second man follows with what is termed the *flaughter-spade* (see Fig. 17) with which spade he cuts the turf line, now formed by the man before him, right across into convenient lengths—say eighteen inches; and as he cuts the turf into those lengths, *proceeding backwards*, he by a jerk of the implement turns each turf as it is formed with its grass side uppermost. Each turf, as it is thus turned up, is laid hold of by a third man, who lays it upon its bed in the forming of the dyke, &c., always taking care to lay the first course of turf three inches within the outer edge *a*, on each side, which is meant to form the margin, in order to support the dyke the more firmly. When the three workmen have got the first course of turfs laid on the stance, they all proceed to have them properly placed, joined in the seams, levelled, and made properly firm; and in the same manner they proceed throughout, one edging off the turfs with a line to an exact measurement corresponding to the width of the dyke as it advances; consequently each succeeding layer of turf, as it is laid on above another, will be proportionally narrower than the one under: a second cuts the turf across into convenient lengths, and heaves them up for his neighbour in order to lay hold of them the more readily and put them upon their place in the building. From the figure representing the turf dyke, it will be observed that the same is built from materials taken equally from each side; and this is necessary in order to the more speedy building of the whole, as well as taking an equal proportion of the surface from each side, which will not cause the making of the one field poorer than the other, as would be the case were the turf taken all from one side.

The thickness of the turfs must in all cases be determined by the nature of the soil. If the soil which forms the turf be light and sandy, the less of such material that is taken up the better, as it is extremely apt to moulder down quickly; therefore, in a light sandy soil, do not pare the turfs thicker than three inches; and if the soil be heavy, four or five inches may answer; but as a general rule in this matter, do not take the turf thicker than you have plenty of the fibrous roots of the grass in it.

It will be observed from the figure that the first four layers of the turf are double—that is to say, two in breadth; and this is necessary, for the great breadth of those under-turfs would render the work difficult were they put on whole. My rule in this case is to make the under half double turf, and the upper half single; and in all cases I put on the upper turf with the grass up.

242. These dykes are generally made about thirty inches broad at the bottom, and tapering regularly upon each side to twelve or fourteen inches at top.

243. In the erecting of all turf dykes, it is of the greatest importance to the future welfare of the same as a fence, to build them at the offset a few inches higher than it is ultimately intended they shall be; because they in almost all cases subside a few inches shortly after being put up. This is the more necessary to be kept in view where the soil or turf of which the fence is built is of a mossy or soft nature; and of this I have, indeed, had ample experience, which makes me desirous of guarding others against

mistakes of the same kind. And in order to make provision against too much subsiding, I here recommend the following hints:—Where the natural surface is very rank of grass or weeds of any sort, cut the same as bare as possible with a scythe previous to cutting the turf; and in the building of the same, if they are damp and spongy, make the dyke at least nine inches higher than you wish it to be; that is to say, if you wish your turf fence to be thirty inches ultimately, make it thirty-nine or forty; but if the turf used be of a moderately firm, loamy soil, three inches may be quite enough to allow for subsiding. Where it is intended to have a paling fence upon the top, as is always necessary unless the dyke be made very high, such a paling should not be put up until the fence has well subsided, else it would fall considerably under the paling afterwards.

244. In all cases of erecting such turf dykes, I recommend putting a paling on the top (see Fig. 16 at *c*), in order to prevent sheep or cattle of any description from getting over into a plantation or adjoining field. If the fence is placed upon the edge of a wood, and meant to protect it only, the paling may be put up as represented in Fig. 16 at *d*; but if it is put up for the purpose of dividing two fields, then the paling must be put up as represented in the same Figure at *c*.

These palings should be of larch-wood, one or two bars deep, well nailed to larch posts driven into the dyke so deep as to go through it into the solid ground. Such turf dykes can be got done for one penny halfpenny per yard; and if we include a two-barred paling, with five posts to the rood of eighteen feet, and also men's time in putting it up, with nails, the whole may be got done for sixpence per yard.

245. There is another form of turf dyke often to be met with in high parts of the country, made after the same manner as the *whin hedge fence* (Fig. 12), which is an exact representation of the same thing; therefore I need not say more upon it here, only that in general, instead of whins being sown upon the top, one or two bars of paling are put on the top according to the height. Such a turf fence as is represented by Fig. 12, with two-bar paling on top, including wood and all workmanship, is generally got done for sixpence per yard.

246. The building of turf dykes should always be done in the spring or the early part of summer, in order that the turfs may be well grown together before winter sets in. On Lord Seafield's estates we have large enclosures fenced by means of the description of turf dyke represented by Figure 12—of course without whin hedges—and they answer the purpose excellently. Sheep are, indeed, apt to rub them much away at the bottom; but in order to prevent this, a few posts should be driven into the ground

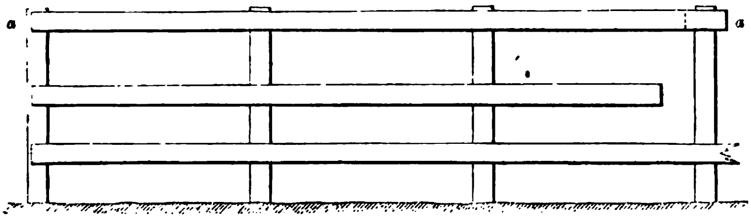
upon the sheep walk, to act as rubbing posts, which will in all cases entice the sheep from the fence.

SECTION 8.—THE METHOD OF ERECTING VARIOUS SORTS OF WOODEN PALINGS.

247. The variety of designs for wooden palings is endless; and for me to give in a work of the present nature anything like a description of those termed ornamental palings, would be superfluous; therefore, in the mean time, I shall confine myself to the description of a few only, and those such as are considered the most useful for general purposes.

The most generally useful of all wooden palings as a structure for a fence is the horizontal (see Fig. 18), and this is, when when well put up, a fence by no means void of ornament. The wooden paling, as shown in the above figure, consists of strong posts generally about three inches diameter, driven into the ground at intervals of three and a half feet in the line of fence, upon which posts the bars are nailed horizontally at regular distances from, and parallel to, each other. As there is no fence more commonly in use than the above in the highly cultivated parts of the country, it will be of importance to make a few practical observations as to the manner of putting it up.

FIG. 18.

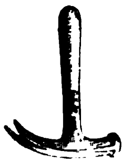


248. Having fixed upon the exact line upon which a wooden paling is to be erected, ascertain the height that will be necessary for the purpose in view; and having decided upon this—say a three-barred paling—then in this case the fence will require to be about three feet high above ground when finished. Next ascertain if the ground be of a hard or soft nature in the line to be erected. If soft, the posts for the paling will require to be put at least two feet into the ground, in order to make them properly firm in their place, and to resist the pressure of cattle; if hard, then eighteen inches in the ground will be sufficient. And, for our example, in the present instance we shall say the ground is hard; consequently,

if the height of the paling, three feet, be added to the necessary depth of the post into the ground—namely, eighteen inches—we have four and a half feet as the length of the posts; therefore let posts of that length be brought forward and laid all along the line, laying down one post for every three and a half feet in length of the fence, which is quite sufficient; and upon having the posts laid down as directed, have the horizontal rails laid down also, beginning at the one end of the line, and laying down three bars together continuously to the other, observing in laying out the posts and rails, to keep them a little to one side of the exact line of fence, in order that the men in working may not be continually interrupted by them lying in their way; and also observing not to lay the rails down carelessly upon the top of the posts, but to have both so distinct that the workmen can have it in their power to lay hold of either posts or rails without their coming into contact with each other. The general size of posts used for this purpose is about three inches diameter, and they may be either round wood, halved, or quartered, as the size of the wood may answer in making them. The best sort of wood for posts which have to be driven into the ground, and which are continually exposed to the extremes of both wetness and dryness in the soil, is the larch. As far as my experience goes in this matter—and I have had much of it—I find that even oak itself, when driven into the ground as a common post, will not last nearly so long as larch of the same age; and I may further state here, that of all the sorts of wood which I have used as posts to a fence, Scots pine and alder are of least durability; and next to these, beech. The horizontal rails for paling are generally made eighteen feet or a rood in length. These are sometimes made of larch, and sometimes of spruce or Scots pine. Larch is out of all question the best for this purpose, and is generally sawn to the size of three and a half inches by seven-eighths of an inch. Spruce fir is, in my opinion, the next in quality for paling rails, Scotch pine being inferior to it for lasting. Both these are generally cut four inches by one inch.

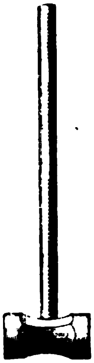
249. The posts and rails being all laid out as directed, the operator will next provide himself with a garden-line for stretching along the run of the fence; also a common nail-hammer, or what is termed No. 3 paling-hammer, with claws for pulling out nails (see Fig. 19.) He will also require a bag for holding the nails, and not have them lying and scattered about, as many carelessly do; this bag may be of leather or of coarse sail-cloth, as may be most conveniently had; and as there are two sizes of nails used in the putting up of paling, the bag ought to be divided into two apartments, by being simply sewed up the middle. Another important

FIG. 19.



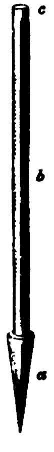
tool in the operation of fencing is what is commonly termed the *post mell.* Many use merely a block of ash-wood about ten inches long and six inches in diameter for this purpose, having of course a handle to it; but a mell of this description never answers well, nor can a workman do much execution with it: they ought all to be made of iron, and may be about 12 lb. weight. Fig. 20 represents the iron post-mell which we use, and which, in the hands of an expert workman, is a powerful implement.

Fig. 20.



If the ground be very hard, and it be considered difficult to get the posts driven in, not only on account of the loss of time that would be occasioned by having the men toiling and beating upon a post for some minutes before they could get it the desired depth into the ground—but also of the waste of the posts that would be occasioned, it will be proper and necessary to be provided with what is termed a *borer* (see Fig. 21). This implement consists of a heavy piece of iron, *a*, which is pointed, round, and hollow in the centre, in order to receive the handle *b*. This pointed piece of iron—or *shod,* as it is termed by the workmen—may be made about twelve inches long, and about three inches diameter at the top where the handle is inserted. The handle should be about four feet long, in order that the operator may have the more lever power upon it; and in making a hole for a post with it, it is forced into the ground by repeated strokes downwards from the workman, who holds it by the top, *c*, in his hands, and is found very powerful in making holes in hard ground.

Fig. 21.



These implements, as described, together with the nails, are all that are necessary for the putting up of a paling fence; and having described them, we shall now proceed to show how they are used in the work.

250. In commencing to put up the paling, all the materials being laid down, first stretch the line along the run of the intended fence, and pin it down about two inches to the one side, in order that the posts may be put in the exact run intended for them; and having done this, cut a piece of wood the exact length that you wish the height of your posts to be above ground when driven in; then, if the ground be hard, take the borer and make a hole with it for the first post; which being done, send the post down by the mell to the desired depth, measuring the proper height of it above with the stick for the purpose; or, which may be more handy, the height may be marked upon the handle of your mell and applied at once to the post. If your rails are of unequal lengths, next proceed to lay a single bar along upon the ground by the side of your line, allowing an overlap of about five

inches at each joining; and having this done, proceed first to put in a post at the joinings of the rails, without regard to exact distances in this case. Upon having a post driven into the ground at each joining of the rails, next proceed to put in the posts between these, to as nearly three and a half feet as the spaces will permit; and after you have the posts driven in regularly as far as your line is stretched, look over them and see that they are regular both on the top level and in a line upon the side view; and this can be readily done by beating down one where too high, or beating with the mell to a side any that may be a little out of the line. Having the posts all properly in, and in proper state, let two men take hold of a rail and place it along the top, forming the upper bar (see Fig. 18, *a a*), and observe to have the end of the rail commencing upon the first post nearly on a line with the perpendicular of it; that is to say, merely covering the breadth of the post, as seen at *a* upon the left hand side of the figure; and the man upon the other end of the rail will observe to have it about two inches over the breadth of the post upon which he nails it, as shown at *a* upon the right-hand side of the figure; this is in order to form a *splice* or joining to secure strength in the part; and in this state let the first bar at top be nailed on, observing to keep it rather under the top of the posts, as shown in the figure. Upon lifting the second bar, which should be a continuation of the upper one, let the man who is hindmost keep his end of the bar about two inches behind the post upon which his neighbour nailed his last joint, as represented at *b* in the figure; and in this manner the two men will go on with the putting on of the top bar the whole length of the line of posts put in, and in the same manner return with the second bar, which should be about nine or ten inches under the upper or first one. In putting on the second and third bars, it is not so necessary to have the joints of these made upon the posts as directed for the upper bar; they may be joined in the middle, or where it may chance to happen, according to different lengths of the rails; because the two under bars are not likely to require to have so much strength as the upper one, which is always pressed upon by cattle, &c. The second bar being nailed on, the third or under one should be put on about seven inches under it; and the reason of thus making the bars closer as they come down upon the posts, is the more readily to keep back sheep or lambs, those spaces being most on a level with their bodies.

In the same manner the whole of the length of the fence is put up, one line-length after another; and in this manner two active expert men will put up twenty-five or thirty roods in one day, where the soil is moderately soft.

The cost of erecting a three-barred paling may be calculated thus :—

	s.	d.
To 3 roods of rails, at 7d. per rood,	1	9
... 5 posts, 4½ feet, at 2d each,	0	10
... 20 nails, at 7½d. per 100,	0	1½
... men's time putting up one rood,	0	3½
	3	0

251. In erecting wooden palings, it will not be always found that three bars will answer every purpose; for where cattle, sheep, and lambs are grazing, four bars will often be found necessary to keep them in; as also it may often happen, that where there is a height upon the line of the ground upon which the fence is to be run, two bars may in such a situation prove as effectual a fence as three or four in other situations. And as I have frequently been asked by proprietors as to the expenses of erecting palings according to the number of bars in them, I shall here give a statement of the different prices of each, which I consider enough upon this head, seeing that whether two, three, or four bars are to be erected, the description given as to the manner of erecting the three-barred is equally applicable to the whole.

252. In the following valuation I calculate upon larch-wood being used:—

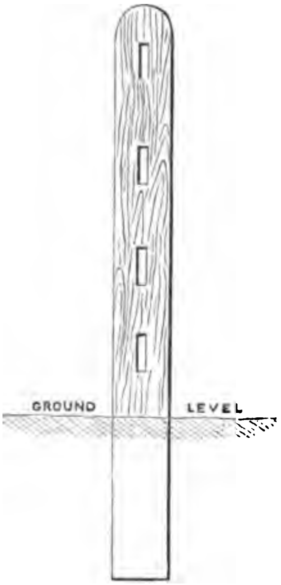
				s.	d.
Cost of a	1-bar	paling with	3 feet posts, per rood of 18 feet,	1	3
Do.	2	do.	4 feet do. per do.	2	1
Do.	3	do.	4 feet 6 inches do. per do.	3	0
Do.	4	do.	5 feet 6 inches do. per do.	4	2
Do.	5	do.	7 feet do. per do.	6	0
Do.	6	do.	8 feet do. per do.	7	6

In erecting a paling above four feet high, if the ground be of a soft nature and not likely to hold the posts firm, three rances may be required extra for the rood, with a foot-pin each. The value of each, with pins, may be stated at 4d., or 1s. extra per rood.

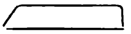
253. There is another description of horizontal paling excellently adapted to protect plantations and to subdivide fields, of which we erect annually a very large extent in Strathspey. It is of a very much stronger character than the one described in the six preceding paragraphs, and forms a more permanent and reliable fence where heavy cattle and horses have to be guarded against. This paling consists of posts put into the line of fence at nine feet apart, with four horizontal bars fixed between each pair, and the usual height over all is four feet, measuring from the land level. The posts are made from good and matured larch or pine timber, six feet long, and sawn to a scantling of seven by three inches. The rails are also made from

matured timber, ten feet long, five inches broad, and one and one half-inch thick. The posts, made of the dimensions stated, are morticed to receive the rails, as no nails are used in the erection of this sort of paling. The mortices are made right through the thickness of the posts, and of dimensions suited to the breadth and thickness of the rails which they are to receive—viz. five inches by one and a-half inch. In order to make the fence proof against small sheep or lambs, we arrange the mortices in the posts so as to have the lower bars closer to one another than the upper ones. The following figure will explain this:—

Fig. 22.



The portion *a* which is inserted into the ground, is twenty inches in length; the portion betwixt *b*, the ground level, and the opening or mortice No. 1 is six inches; the portion betwixt the mortices 1 and 2 is six inches; that betwixt the mortices 2 and 3 is seven inches; that betwixt the mortices 3 and 4 is eight inches; and above the uppermost mortice there is five inches of whole timber left in order to maintain sufficient strength to prevent splitting after all the mortices are made, and in driving home the bars.

In order that the rails may be made to overlap properly and firmly, as well as that they may be inserted into the mortices, a slice is removed from each end of every one of them, and for this purpose a sharp *adze* is used. In removing the slices from the ends of the rails, it is done all from one side ; so that when any two ends are put into a mortice, it is only necessary to place the sliced side of each, the one to the other, in order to have a complete junction, and a continuous line of rail. The slice may be from four to six inches long.

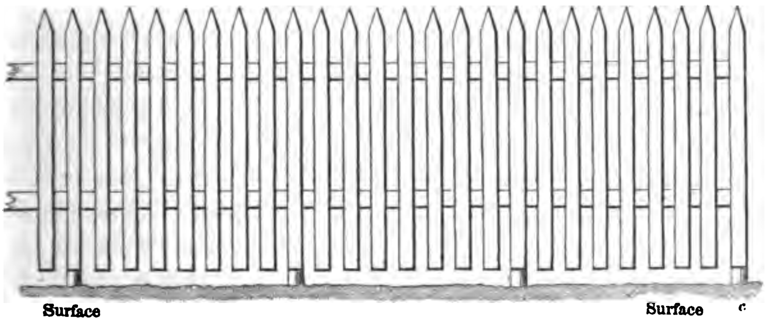
254. I shall give a short description of our own mode of erecting this sort of fence. The timber is prepared for it as specified in the foregoing paragraph, and this should be all done at the sawmill at which the wood is cut up. We have it laid down along the line of fence in a regular and systematic way, and while this is being done, we have the holes or pits made, at exactly nine feet apart, to receive the posts. In erecting the fence, after the first post has been fixed in its place—and each must be made firm in its place by using four stones, the first two, one on each side of the post in the bottom, and the other two, one on each side of the post at the surface of the hole, all put in firmly betwixt the posts and the outer edge of the

hole,—the ends of the four bars are at once put into their mortices in it. This being done by two men, other two are at the same time employed putting the second post into its hole, and before they commence to fix it they place the other ends of the four rails, which were inserted into the first post, into the corresponding mortices in the one at which they stand; and immediately after this is accomplished, they fix the second post, while the two men who were engaged with the first go on to the third one, and so on alternately, always inserting the rails into the last post before fixing it in its place on the line; in the same way any length of the fence may be put up. We have fences of this kind in Strathspey which have lasted upwards of thirty years, and this because they had been made of good timber. The entire cost of their erection and value of wood is about 8d. per lineal yard of the paling.

255. Next to the horizontal palings which have been described above, the most important and generally useful is the *upright*, which is made of various heights in order to suit different purposes. It will be enough for me to give an example of the manner of putting up one of these; and by referring to Fig. 23 this will be readily understood.

Fig. 23 is a sketch of an upright fence made of larch-wood. The upright spars, as shown from *a* to *a*, may be either sawn wood, three inches by three-quarters of an inch, or small larch trees three inches diameter, cut up the centre by a saw-mill, according to taste. I shall here suppose that we have to erect a fence of the description above stated, and that it is to be five feet high.

Fig. 23.



In the first place, have all materials brought forward, and the line stretched along the run of the intended fence, in the same manner as directed for the putting up of the horizontal fence, and put the posts into the ground in the same manner as there advised, observing to keep them about four feet distant from each other, and allow the tops of them to be twelve inches under the extreme height of the uprights; consequently the posts for a five-feet spar fence will require to be four feet high above ground when driven in. The posts being put in along the whole length of the first line, and carefully levelled along the tops, at least in such a manner as to correspond with the nature of the ground, the next part of the work is to have the upper rail nailed on to the exact height of the tops of the posts, observing to join the rails upon the posts in the same manner as formerly advised; and the upper rail being nailed on, the second (there being only two horizontal bars in the fence at present under notice) must be nailed on and joined upon the posts in the same manner, keeping about sixteen inches from the surface of the ground, or two feet under the upper one. In putting on the upright spars upon the frame-work now formed by the posts and two horizontal rails, have one of them nailed on at the extreme end where you intend commencing, observing to keep the top of this upright twelve inches above the upper rail *b*, and place it at the same time so as to cover the post forming the extreme end, as at *c*—the post appearing at bottom only; and in the same way go on putting on an upright upon the face of every third post the whole length of your line of posts, being very exact in measuring the top of each to twelve inches above the upper bar; and when this has been done, put a nail into the top of each of these uprights, but only so far into the wood as not to be taken out easily without the aid of the hammer. On having put a nail into the top of each, have your line tied to the one upon the extreme end, and go along with it in your hand, making one turn of it round each nail as you pass along, keeping the line tight as you proceed; and having stretched it along the tops of the spars tightly by the use of the nails, the line will now act as a top guide for putting on all the rest of the spars between to their proper height, which could not have been done easily otherwise. The fence being five feet high, the uprights will require to be only four feet nine inches in length, they being kept three inches up off the ground or surface, as seen in the figure. In putting on the spars, pay no attention particularly to their regularity at bottom, but be very particular as to how they range and take the eye at the top. In nailing on these spars, be careful to have them put on as near the perpendicular as possible, keeping from two to three inches of open space between each two; and always endeavour to have an upright put on so as to cover each post from the view, which can be easily done by a little attention in regulating them. A fence of this description should always have the spars nailed upon that side which is to be most seen; consequently, this point should always be taken into consideration before commencing the work.

The cost of erecting, per rood of six yards, an upright larch fence five feet high, such as I have just described, may be calculated as under:—

	s.	d.
To 4½ posts, 6 feet long, at 4d. each, . . .	1	6
... 2 roods rails, at 7d. per rood, ...	1	2
... 48 upright spars (*small larches halved*), at 1½d., .	6	0
... 100 nails, at 7½d., ...	0	7½
... men's time putting up 1 rood, ...	1	0
	10	3½

256. There is another description of upright paling fence, which until lately was much used throughout Britain—namely, the *stob dyke*, as it is termed in Scotland. This fence is still often to be met with in many parts of the country, and consists of a continuous row of wooden posts driven into the ground, nearly as close as they can be got to one another, and bound together at the top by one bar or rail, with a nail through it into the head of each post. This sort of paling, from the great quantity of wood used in it, is expensive at the outset, and is now, in all cultivated districts, superseded by the horizontal paling, which is superior in every respect, being more durable, and cheaper in the first instance also. It is not, in my opinion, worthy of being continued as a fence; for even where it is thought much of on account of its closeness in producing shelter, a much better fence is produced by the upright spar, which will last double the time of the stob dyke, and is infinitely more elegant. From the posts which form the stob-dyke fence being all inserted into the ground, they soon waste, and in fact all waste at once, and must be entirely renewed; but the upright spar, or the horizontal paling, having only a few posts in the ground, these can be renewed, and the rails answer a second set of posts, as I have often experienced.

SECTION IX.—THE ERECTING OF WIRE FENCES UPON WOODEN AND IRON POSTS.

257. The wire fence, from the nature of the materials of which it is made, is decidedly the most ornamental of all; but although it must be admitted to be so, and although, from the nature of the material, it will last much longer than a mere wooden fence, great caution is necessary in adopting it in many situations. As I intend, in another section of this work, to give a few hints and suggestions as to the propriety of using a particular fence in a particular situation, and for a particular purpose, I shall not, in the mean time, enlarge upon the utility or non-utility of the wire fence, but proceed directly to a description of the practical part of erecting them. In this I hope to be able to give such directions as may enable any intelligent man to erect them in a perfect manner.

258. Figs. 24 and 25 represent the extreme ends of a wire fence upon wooden posts, nearly four feet high, and adapted to resist sheep and cattle.

FIG. 24.

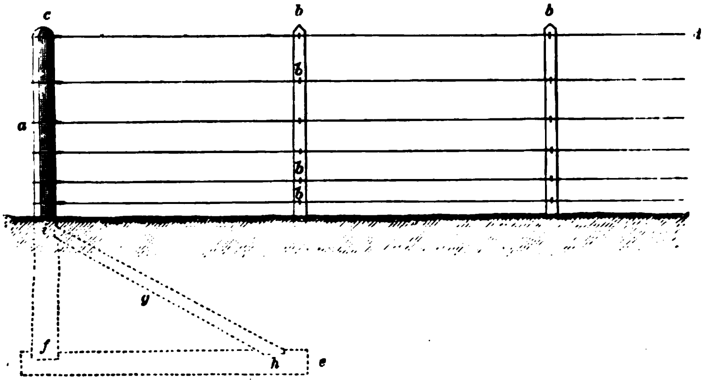
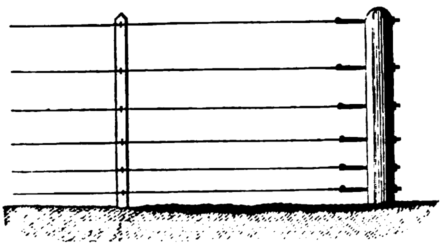


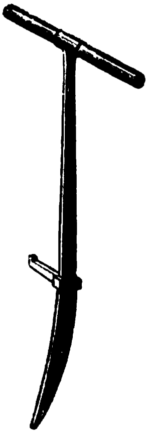
FIG. 25.



The exact line for a wire fence being fixed on, have the first *post* or *straining-pillar*, *a*, Fig. 24, made as there represented. Have it made of the best larch-wood, taken from a full-grown tree, the wood of which may be considered matured and full of resinous sap; and not of the wood of a young tree, as is too often done, which, although apparently as good, will not endure nearly so long as that of a full-grown tree. The wire fence for sheep and cattle, as here represented, is in general made three feet nine inches high from the surface of the ground to the top wire *d;* consequently the post *a*, which is sunk three feet into the ground, will require to be made seven feet long, allowing four inches for the round upon the top above the level of the upper wire, as at *c;* and if it is to be made octagonal in shape, as is generally the case, it will require to be at least eight inches diameter, measuring from any two opposite sides. In preparing the straining-post, it is advantageous to the strength as well as the duration of it, not to take any of the outer wood off the part which is to be sunk in the ground; for the more bulky that part is, so much the greater, in every respect, will be the stability of the work. Therefore, in dressing the straining-post, only do so to the part which is to be above ground, and, if possible, put the lower part in with the bark upon the wood, as in the natural state, which will preserve it from rot better than either charring or tar could do. Having the post made with half-inch holes bored through it at proper distances for the reception of the wires, as shown in the Figure, have another piece of larch prepared, six feet long, eight inches by six inches, to act as a sole for the post to rest upon in the ground, as indicated in Fig. 24 by the dotted lines at *e e*. In this sole cut out a part upon the broadest side, about two and a half inches deep, the whole breadth of the wood, large enough to hold the bottom of the post in it, as at *f*,—observing to leave about four inches upon the end for a heel; into this groove fix the bottom of the post, as shown in the Figure, and secure its firmness by two very large nails driven through the post into the sole. This being done, have another piece of larch wood, *g*, of such length as to have the one end fixed in another groove to be made near the point of the sole, as at *h*, and the other end in another groove, to be made only one inch deep, upon the post a little under the surface of the ground, as at *i*. This piece of wood, which should be about seven by three inches, is called the underground stay, and is meant to act as a support against the strain of the wire; while, at the same time, it is not seen above ground, and consequently gives the fence a light and neat appearance when finished. A quantity of tar should be put in the groove *i*, before the end of the stay is put into it, as it is at this point that the timber of the post is most apt to decay, from wet lodging at the joint.

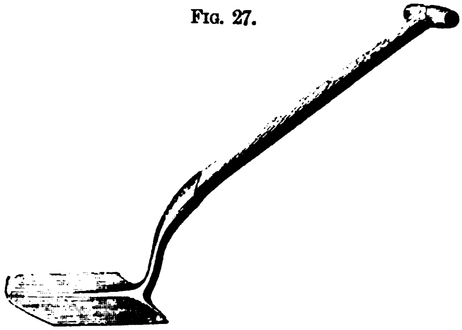
259. The first straining-post having been completed in the manner stated, the next step in the work is to have a pit dug in the ground for its reception, observing to make the one end of it exactly where the fence is meant to begin, extending it in the direction of the line of fence very exactly, so far as to hold the sole when put in, and about three feet deep. In making these pits for the reception of the posts, the ground is in almost all cases found so hard as to require picking, in the under half at least; and as it is highly necessary to make the pits as near the exact dimensions of the wood to be put in as possible, in order to have the more solid ground about the posts, it is often a work of considerable difficulty to make them without proper implements. This I wish to draw particular attention to, having frequently had occasion to see a man work half a day in the making of a pit for a post with improper tools, who, had he had proper ones, could have done the same work in one hour. The implements I use in the making of the pits for wire-fence posts, as also for gate-posts in general, are the common garden-spade, for digging off the surface turf and upper soil, and the *foot-pick*, Fig. 26, which I use instead of the common hand-pick.

FIG. 26.



There being no sufficient room for a man using the hand-pick, but with great disadvantage, in the making of pits, I in all cases of this nature use the foot-pick, which is a most efficient instrument in the hands of a powerful man, enabling him with great ease to loosen the hardest subsoil or stones in the making of a pit. The *horizontal spade*, Fig. 27, I in all cases use when removing soil eighteen inches under the surface. It has a handle about two feet long. With this implement a man can work with great freedom in the pit, where he is much confined for the want of room; and with it he can do more than double the work, in such cases, that he could do with the common spade.

FIG. 27.



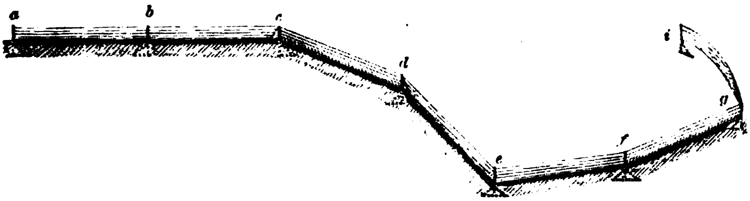
The pit having been thus made, and properly levelled in the bottom, the straining-post is put down into its place, observing to place it perfectly upright. For the purpose of ascertaining this correctly, a piece of cord with a weight upon the one end of it is used (see Fig. 28), which is taken in the hand by the one end, as at *a*; and held up hanging between the eye and the post, while the operator is standing about three yards distant from it. In this position the plumb *b* is allowed to settle, when the eye of the person in observation will in a moment observe whether the post correspond with the perpendicular of the line: when taking this observation, one man should hold the post to the spot he is desired by the observer, and another should put a little earth into the pit to keep it in its place. As soon as the post is placed upright, two wedge-shaped pieces of larch-wood, something in the form of the pointed end of a strong post—say about eighteen inches long—should be in readiness. One of these should be beat obliquely into each end of the pit, as at *e e* in Fig. 24, between the solid earth and each end of the sole. This is meant to secure the stability of the sole in its place, and, consequently, they ought to be well driven home. The operator being satisfied as to the erect position of the post, the next point is to have the earth which comes out of the pit well broken down, and filled very gradually into it again. In this filling, however, not more than three inches deep of the loose soil should be put into the pit at once, without having it properly beat to a perfect solidity with what is termed a *rammer*, which is merely a piece of wood in the shape of a common post, about four and a half feet long, having a piece of

FIG. 28.

iron upon the under end in order to make it more heavy for beating the earth. By alternately laying in about three inches of loose earth into the pit, and beating it firmly as directed, and observing at intervals, by the plumb-line, if the post stands right, and is not put out of its position by the beating, the securing the necessary resistance to the strain of the wire is attained. I may observe here, that previous to putting in the post with its sole, all that part which is to be under ground, if the natural bark be not upon it, should be well painted over with hot tar, which has a great tendency to preserve the wood; but by no means char the wood, as many do. I must say that the charring of larch-wood, in particular, is injurious to its durability; and this I have had many proofs of. It carries off the resinous matter, which is so plentiful in this wood, and which resists the action of the water, making the wood more porous, retaining the water, and of course encouraging rot.

260. Having got the first straining-post put in, observe next if the ground upon the line of the proposed fence is level or unlevel; for a great deal depends upon this, and the manner of going to work must be regulated accordingly. In order to illustrate this clearly, we shall now be assisted by referring to Fig. 29, which is meant to represent a continuation of a line of wire fence both upon level and unlevel ground.

FIG. 29.



261. We shall now suppose that the first straining-post *a*, in Fig. 24, is represented by the post at *a* in Fig. 29, and is now properly secured in the ground, agreeably to the directions given. Now, the ground from the post *a* to the post *c*, which is perfectly level, we shall suppose to be about one hundred and sixty yards in length; therefore this space is too great in order to be properly tightened up between the two posts *a* and *c*; we must therefore have another post between them, as at *b*. I ought to observe here, that in all cases of putting up wire fences, never have straining-posts, if possible, more than eighty yards from each other. If they are wider, the proper tension of the wire cannot be attained so as to make a secure fence; consequently the next step in the progress of the work before us is to put up another post at *b*, half distance between *a* and *c*. This post is put in exactly in the same manner as has already been described for

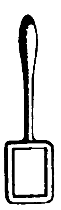
the first one; only it must be observed to put the underground stay of the second post in such a position as to resist the strain of the wire from the post at *a*. This is effected by placing the stay the contrary way of the first one, as seen and represented in Fig. 29 at *b*, the stay upon the post there not lying in the same direction as at the post *a*, but the contrary, thus making each pair of posts complete in themselves, and independent of another, which is the point required. The second post being secured, the next thing to do is to have the intermediate uprights or standards brought forward, which are represented in Fig. 24, *b b*. These should be of the best larch-wood; six feet long, and four and a half inches by three. Before putting them into the run of the fence, have one line stretched tightly between the bottoms of the two straining-posts upon the surface of the ground, and another between the tops, or in the exact position of the intended top wire, running each end of it through the upper hole in each post, which has been prepared for the reception of the upper wire; and upon having both lines stretched as a guide for top and bottom, in putting in the intermediate uprights, have them put in five feet apart, upon the opposite side of the line that it is intended the wire shall be put on; or in other words, let it be understood that the hempen line is in the exact place where it is intended the upper wire shall be; and upon a due consideration of this matter, it can at once be decided upon which side of the line the posts ought to be placed. Another point necessary to be considered at this stage of the work is, to put the wires upon that side of the posts where it is known there will be most necessity for strength on the part of the fence; for if heavy cattle be upon the opposite sides of the wires, they are very apt to press out the staples which hold the wires to the wood; while upon the other side they can have no effect whatever upon it.

With regard to the method of putting in the intermediate uprights or posts into the ground, some make holes for them with the spade, and place them in. Some years ago I adopted this plan, but found that uprights put in in this way were very apt to become loose afterwards, as it is not an easy matter to have men always so faithful as to attend to beating them firmly into the ground. Besides, I have found this method very expensive, occupying much useful time; and, in fact, I never found it preferable to beating in the uprights in the same manner as I do posts in a common paling. And now, after ten years' experience in the putting-up of wire fences, I in all cases drive them into the ground by the *paling mell*, using the borer in order to open the ground for their points. By this method I in all cases find the uprights stand more firmly than when put in by the spade entirely. In erecting such fences, however, on land in which there are quantities of small and large boulder stones, I have been obliged to open pits for the intermediate posts as well as for the straining-posts, but where the land is at all free of such—as in all well-cultivated districts of the country it is—this expensive mode of the operation may be dispensed with; and I make this remark merely to show that in stony land it is found necessary to make pits for all the posts.

262. Before putting in the uprights I have them well painted with tar in the under part, more particularly about six inches under and above the surface.

263. In order not to spoil the heads of the intermediate posts in beating them into the ground with the mell, I have an implement made of iron, the exact shape of the top of the posts, four and a half inches by three inches, inside measure, which fits exactly, and indeed rather tightly, upon the tops. (See Fig. 30.)

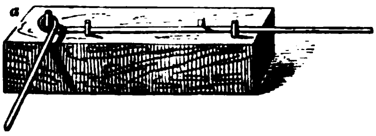
FIG. 30.



In beating in the posts a man lays hold upon the top of each by this implement, as shown in the Figure; by using it, the posts are not hurt upon the top by the action of the mell; and, besides, the man holding them thus at the top has a great power over them, and can turn them whichever way he pleases, if they happen not to go in right: on this account I term it the *post guide.*

264. The posts having been put in five feet separate from each other the whole length of the line between the two first straining-posts, very exactly with the run of the line both at bottom and top, and three inches of the top of each upright being left above the line or run of the upper wire, in order to strengthen the fixature of the wire at top—as may be observed by glancing at Fig. 24, where it will be seen that the top of each post is a little above the top wire—the next thing will be to have the wire prepared or drawn for putting on between the two straining-posts now in readiness to receive it. The wire, as it comes from the manufacturers, is in general rolled up into bundles, each containing from forty to eighty or one hundred yards in length; in these bundles the wire keeps its circular form, and consequently will not answer the purpose of lying along between the posts until it be drawn out in the form of a straight line, and that in such a manner as to make it keep the straight form when it has received it. In order to do this, an instrument containing a set of *pegs* is used, in the form of Fig. 31, which consists of a block of hardwood, about two feet long by six inches broad and three deep. Upon the upper surface of this are set two rows of iron pegs, about two inches long, well driven in, and about three

FIG. 31.



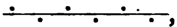
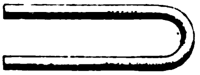
inches separate from each other in the line. I have said that there were two rows of pegs set into this instrument, but these two rows are set in a particular alternate manner; and, to a person unaccustomed to it, my explanation, as above given, may not be explicit enough. The following sketch will, however, make it clear: the two rows of pegs are set alternately upon the piece of wood thus— , the distance between them being exactly that of the diameter of the wire to be drawn through between them, which is represented in the above cut: consequently, in making the instrument, a piece of the wire which is to be straightened should be laid upon the wood, and the pegs driven in upon each side to answer it. I lately bought an instrument of this sort with two rows of small wheels fixed on the block of wood instead of the pegs, and which are adjusted by screws. I have tried its working, but did not find it answer the purpose any better than the instrument I have described, although it certainly is easier for the men to work with; and I merely refer to it with the view to record that such a thing is now in use among parties who put up wire fences. It is to be had from Messrs Young, Peddie, & Co., Edinburgh, who sell it at £1, 10s., under the name of the IMPROVED WIRE-STRAIGHTENING MACHINE. In the act of straightening the wire by the use of the pegs, the instrument is laid upon a small bench about two and a half feet high, of any rough description. Let this bench be placed close to the side of one of the straining-posts, and lay the peg-block flat upon it; and, by a piece of rope passed through a staple which may be inserted at *a*, attach it firmly to the post. Then bring forward one of the bundles of wire; loose out one end of it, pass it round the small upright, as seen upon the face of the block, and bring the end of the wire through between the two rows of pegs, as represented in the Figure. On having the end of it passed through, make a turn upon this end, and pass a good strong stick through it, by which two or three men may pull and draw the whole length of the wire through; as the men pull at the first end of the wire which was put between the pegs, another man must attend to unroll the bundle before it passes through the staple, or, if this is not strictly attended to, the wire will not come out from between the pegs straight; and in this manner draw out as much wire as will be required for six lengths between the two straining-pillars, which is the number required for the fence now under our notice. Before taking down the line which was stretched between the tops of the two straining-pillars for the purpose of regulating the tops of the uprights, and which, of course, will be in the exact place where the top wire of the fence is intended to be, have it stretched very tightly; when properly tightened, mark with a piece of *black coal* (as used by carpenters) the exact track of the line along the top of the posts, and then take the line down. On its being removed, have staples prepared for nailing the wire to the posts: they are made of the same material as the wire itself; are about two inches long (see Fig. 32), and generally made without points.

Fig. 32.



265. Have one of those staples nailed or driven into each post upon the mark made by the black coal, and right in the middle of the wood; and upon having them driven in about half length all along, one upon each post for the upper wire, have the latter then run through the upper hole of the first pillar, and through each of the staples in the posts. One end of the wire is fastened to the post *a*, Fig. 24, by being brought half round it, and twisted by means of the *turn-key* (see Fig. 33) round the wire inside of the pillar or post. Should it be too short to reach the next straining-post, it must be joined to another piece of wire of the same description, and brought up to it. In joining one piece of wire to another, it is done by forming an eye or loop on the end of one of the wires: in forming this eye, the end of the wire is held by means of the *clams* (see Fig. 34); and while one man holds the wire by means of this instrument, another assistant turns or twists the end round the wire, in the same way as at the post, by means of the turn-key, which has holes in it for receiving the end of the wire. An eye being made upon the end of one of the wires, the end of the other wire which is to be joined to it is then passed through it, and twisted in the same manner as the other; thus completing the joint or knot, which, when finished, will have the appearance shown in Fig. 35.

Fig. 33.

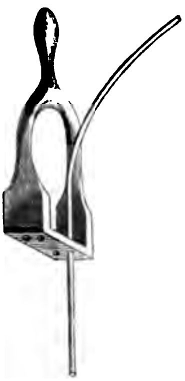


Fig. 34.

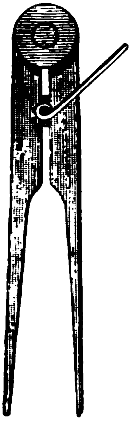
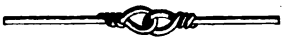
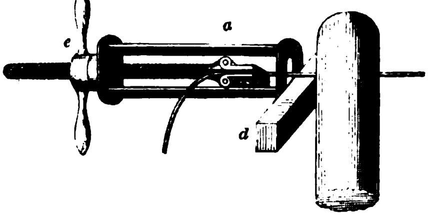


Fig. 35.



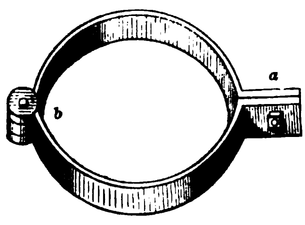
266. The joining being finished, and the wire brought up to the second straining-post, it is then cut a foot beyond the post, where it is now to be finished. In fixing the wire upon this second straining-post, pass it through the upper hole prepared for it, corresponding to that on the first post; then attach the *straining-screw* (see Fig. 36) to it.

Fig. 36.



This straining-screw is attached to the wire by means of a jointed *vice*, as at *a*, which is opened or closed at pleasure by means of a *screw* and *nut* wrought by a screw-key, and can be made to hold as tightly as if it were all a solid piece ; the wire being passed through the upper hole of the post, as already directed, it is taken hold of by opening the *vice* at *a* and screwing it tight upon the end of the wire. But before beginning to tighten or screw up the wire, place a piece of wood (see Fig. 36 at *d*), about two inches thick, between the end of the screw and the post, close to the under side of the wire: this, after the wire is sufficiently strained, allows the *collar-vice* (see Fig. 37) to be applied. Having the straining-screw all in readiness, screw up the wire by turning round the handles *e*, till the desired tension is gained, which may be known from the wire in its whole length between the straining-posts being tight as a string upon a musical instrument. There is now in use, however, a *new straining-screw, combining the collar-vice.* This is an improvement in the erection of wire fences, as it saves the trouble of adjusting the collar-vice, as here explained. We got one ourselves the other day from Messrs Young, Peddie, & Co., Wire Merchants, 77 George Street, Edinburgh, from whom this improved tool may be procured ; the cost is £2, 2s.

Fig. 37.



267. The collar-vice, Fig. 37, is now opened by unscrewing the vice at *a*, when it opens freely before the joint *b*. It is then put round the post, close to the upper side of the wire, and screwed again upon the wire inside of the pillar, the part *b* resting upon it. The straining-screw is then slackened and removed, the *collar-vice* holding the wire in its position. The wire which projects or hangs out behind the post is now taken half round the same, the end being passed over the upper side of the wire between the jaws of the collar-vice and the post. It is then fastened in the same manner as at the other end, when the collar-vice can be removed. There is also an implement, on the principle of the lever, now used by some for straining wire fences instead of the screw, but as we have not yet used it ourselves, we merely refer to it as being in use. Mr M'Corquodale, wood-manager to Lord Mansfield at Scone, near Perth, uses this instead of the screw, and he informs me that in many respects it is preferable to the screw. Those who may wish to try it will receive all information from Mr M'Corquodale regarding it,—and we recommend this, as we know he will be glad to inform any practically as to its use.

268. In putting up our wire fences, instead of tying the wire round the second post as I have described, which is the usual way, I have it attached

to a screw-bolt, through an eye upon the one end; and passing it through the hole in the post, I have a *screw-nut* upon it outside the post. By this means I can at any time, when the wire becomes slack,—and it does become slack in summer from expansion by heat, and too tight in winter from contraction by cold,—tighten it or slacken it off; whereas when it is tied at both ends, it cannot at any time be made tighter without undoing the tie and tightening it up anew by the aid of the straining-screw. These screw-bolts I get made twelve inches long, which leaves, after passing through the thickness of the post, three inches next the wire, and two inches behind the post where the screw-nut is upon. There should be at least three inches of the end with a screw upon it, so that the wire may be either slackened or tightened at pleasure as necessity may require. In putting on these screw-bolts upon the wires, the same operation as above stated is gone through, until the collar-vice is fixed; and then, instead of tying the wire round the post as has been directed, attach it to the screw-bolts, and secure them by means of the nut, when the collar vice can be taken away.

This is represented in Fig. 25, which is meant to represent the one end of a wire fence tightened up by the screw-bolts and nuts; and in this case Figs. 24 and 25 represent the two ends of one wire fence, the wires upon the post in 24 being tied, and those upon 25 being secured by the screws.

In the same manner as has been detailed for the putting on of the upper wire of a wire fence, all the others also are put on; in all cases observing to keep the distance between the wires closer at bottom than at top. In general, where sheep or lambs are, I keep the distance of the two lower wires five inches, widening them gradually to ten inches between the two upper ones.

269. Fences of this description can be made of any convenient height. We have them for deer, six feet high; these having ten wires in depth, instead of six as is generally allowed for sheep and cattle. But, however high those fences may be erected, the work is all done upon the same principle, save with this difference: In erecting a wire fence above four feet, it is always necessary to have an iron stay put to the straining-posts above ground, as well as a wood one under, in order to secure them the more perfectly against the strain of the wire. These stays are sunk into stones and batted with lead; the stone for one of such stays ought not to be less than eighteen inches cube, and sunk about three inches under the surface.

The higher the fence the deeper also ought the post to be sunk into the ground. In erecting a fence of this description six feet high, the sole of the ground stay would require to be four feet under the surface. Where the wire is tightened by the aid of screwed eye-bolts at the one end, the staples should not be driven home in the uprights; but there should be room left for the wire to move through them, else the screw will not have the effect of tightening the wires when it is found necessary. As soon as a wire fence is finished, the posts ought to be painted with hot tar, and the wires with common oil-paint; for if it is allowed to remain any time without being painted, the wire will soon become rusted, and will be apt to break if weakened by being corroded.

270. What I have said relative to the putting up of wire fences, is only applicable to a length between two posts, and that upon level ground; and, in order to make this branch of fencing more properly understood, I shall continue my observations a little further. When I last referred to Fig. 29, I said that from the post *a* to the post *c* was all level ground, being one hundred and sixty yards in length: we have now finished the half of this space—namely, from *a* to *b*—in the above details of the manner of erecting the wire fence. We shall now suppose that we are to erect the other stretch, from *b* to *d*: in this part it must be observed that the posts *c* and *d* are erected upon points from which the ground falls away suddenly; and in this case it is necessary to have either double wood stays under ground, as shown at *e* and *f*, or an iron stay to each above ground, upon the sides of the posts opposite to those upon which the underground wood ones are. The reason for having these extra stays at these two posts is, that supposing the wire were to be suddenly broken between *c* and *d*, the great strain acting upon these two posts, from *a* on the one hand, and from *e* on the other, would very likely pull them suddenly backwards, and disarrange a considerable part of the fence. Now, the simple precaution of having another stay put up at each, prevents this from taking place under any ordinary circumstances; but, in every other respect, the wire fence is put up in the same manner as has already been detailed. In all hollow parts of the ground upon which a wire fence is erected, the posts at such parts should be sunk deeper than upon level or prominent parts; and the soles used there should also be much heavier than those commonly used, and with heavy ground stays, one on each side of the post, as shown at *e* and *f*. The reason for this is, that were these posts put in in a manner which might answer perfectly well at *c* or *d*, the great strain of the wire upon each side of them would not only endanger their security as a permanent fence, but it would draw them entirely out of the ground—a result I have witnessed several times. On a little reflection, it will appear evident that the strain of the wire at *c* and *d* tends to press the posts downwards into the earth; while, on the contrary, at *e* and *f* the strain tends to lift them out; which at once points out the necessity there is for attending to this point very minutely.

271. We shall now suppose that we have the fence finished as far as the post *g*, from which it takes a bend. Now, all the difference in erecting a wire fence upon a bend from erecting it upon a straight line, is, that the posts forming the angles of the bend *g* and *i* require to have an extra stay above ground upon the inside of the curve; and every intermediate upright must also have a stay either under or above ground, in order to resist the pressure of the strain inwards; but if the curve be moderate, a stay at each second or third upright may be quite sufficient. In all cases where a gate occurs in the line of a wire fence, that should be made to have the same appearance as the fence itself, putting in the same number of horizontal wires in it that there are in the fence.

272. We now come to speak of the cost of erecting wire fences upon wooden posts; and of course the price must in all cases vary according to the strength of the wire used, as well as according to the height of the fence to be erected. There are five sorts of wire used in the erecting of those fences,—those wires being known according to their numbers respectively, thus: No. 4 is fully 3-12ths of an inch in diameter, and is the sort used for red deer or horses; No. 5 is exactly 3-12ths of an inch in diameter, and is the sort generally used for fallow-deer, heavy cattle, and horses; No. 6 is fully 2-10ths of an inch in diameter, and is the sort generally used for sheep and small cattle; and Nos. 7 and 8 are nearly 5-24ths of an inch in diameter, and are used for sheep and lambs only.

273. I shall here give the cost, as I have put them up myself, of three kinds of wire fences upon wooden posts; the latter being of the best larch timber, cut at a saw-mill to the exact sizes.

Cost of erecting a wire fence six feet high, for deer, with No. 4 wire, per eighty yards in length.

To 2 straining-posts, 10 feet long, 9 by 9 in., at 8s., . .	£0	16	0
... 2 soles for do., 6 feet „ 9 by 5 in., at 3s., . .	0	6	0
... 2 underground stays, 5 feet long, 7 by 4 in., at 1s. 6d., .	0	3	0
... workmen's time putting in the above, ...	0	3	0
... 40 uprights, 8 feet long, 4½ by 3 in., at 1s., . . .	2	0	0
... 80 yards of 10 horizontal wires, at 1s., ...	4	0	0
... 2 additional iron stays for pillars, at 10s., . . .	1	0	0
... painting wire, at 2d. per yard, ...	0	13	4
... men's time erecting fence, ...	0	6	0
... tarring posts and all wood-work, ...	0	3	0
Total cost of erecting 80 lineal yards, ...	£9	10	4

Being about 2s. 4½d. per lineal yard.

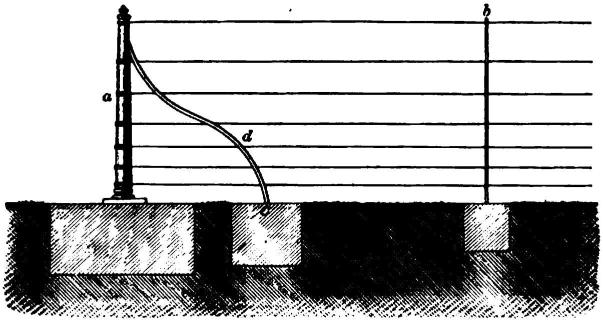
For every 80 yards beyond the first, of course only one straining-post, sole, and stay will be required; reducing the expense to about 2s. 3d. per yard.

The cost of erecting a wire fence upon wooden posts, six wires deep, for sheep and cattle, of the same description as I have detailed in the former part of this section, being three feet nine inches high, and calculating upon the same principle as above, is about 1s. 3d. per yard; and the cost of one erected with No. 7 wire, for sheep only, three feet high, will be about 10d. per yard. It must be kept in view, however, that the price of the wire is at all times regulated by the market-price of iron.

274. We now come to refer a little to the putting up of wire fences upon iron posts or uprights. But having said so much relative to putting up those with wooden posts, it will not be necessary for me now to enter minutely into detail upon the erecting of iron ones, seeing that they are both put up upon the same principle. I will therefore only state under this head what I consider peculiar to it as compared with the other.

Fig. 38 represents a wire fence upon iron uprights, having seven horizontal wires, and four feet high. The straining-posts or pillars may be made of either round cast-iron, or of square wrought-iron, according to taste.

FIG. 38.



The straining-post *a* is sunk and batted well into a large stone at least three feet square on the surface and eighteen inches deep. The stay *d* is also well sunk and batted into a large stone eighteen inches square and fifteen inches deep; and in putting in these stones, they should be firmly bedded into the ground, so as not to yield afterwards by the strain of the wire. The straining-post *a* is generally made of two-inch-square iron, and the stay *d* of double iron, each piece half an inch by one inch, allowing the wires to pass through between. The upright *b* is generally one inch by a quarter or half inch, according to height or strength required, and is also sunk into a stone about twelve inches cube, well batted with lead. These are the only differences worthy of notice between the erecting of a wire fence upon wooden posts and one upon iron; for in the actual erecting of the two the same implements are used, and the same method of working from beginning to end is pursued. Having said, therefore, so much upon the method of erecting the fence upon wood, it is unnecessary for me here to say much more, as it would merely be a repetition of the same thing; the only difference being, that in the erecting of a wire fence upon iron posts, these are sunk in stones, the surface of which must be covered by three inches of earth, whereas with wooden posts these are merely driven into the ground. I may, however, remark, that instead of the horizontal wires upon the iron fence being fixed by staples upon the side, as is the case in the wooden uprights, they are run through holes bored in the centre part of the iron uprights; and in order to prevent strong animals from pressing the iron uprights to a side, they are what is termed *wedged;* this being done by inserting a small iron wedge, or nail without a head, into two of the holes in each standard—say one at the top wire and one in the middle, and immediately above the wire; but this should not be done until the standards are made perfectly plumb and the fence finished, when the wedges should be driven as firmly as possible. In a wire fence upon iron standards where curves occur in the line, it is also necessary to have stays of iron put to the standards on the inside of the curve and against the strain.

275. It now only remains for me to state the prices of wire fences upon iron posts: in this case, as well as in the other, much depends upon the strength of the fence required, as well as upon the price of iron at the time; and, moreover, much depends upon the convenience in getting stones. Indeed, where stones are not to be had conveniently, I have used blocks of larch-wood instead. These may be round timber, about eighteen inches long by nine inches diameter; but in all cases stones are preferable if they can be got. The following quotations are the prices per lineal yard, including all expenses of stones, labour, iron, &c., of three different heights of wire fence upon iron posts, as I have had them made in the neighbourhood of Edinburgh:—

		s.	*d.*		*s.*	*d.*
Cost of fence	6 feet high, for deer, from . .	4	6	to	5	0
Do.	4 feet high, for sheep and cattle, from	2	6	to	3	0
Do.	3 feet high, for sheep only, from .	1	9	to	2	3

In giving the above quotations as to the prices of wire fences, whether upon wooden or iron uprights, I am aware that many do them more cheaply; but, at the same time, I presume to say, not nearly so efficiently. Many, with the view of erecting a cheap fence, put in their posts from seven to nine feet apart, and the consequence is, that the whole soon becomes slack and unserviceable. I never have the distance more than five feet, and in all cases endeavour to make efficient work: in proof of this, the wire fences at Arniston may be referred to.

I may further add, that all wire fences, whether upon wooden or iron posts, should have the iron-work painted each year for the first two years after being erected; after that period, each second year will be enough. In the summer season the wires of all these fences are apt to expand in warm weather, and consequently become slack: in such cases the screwed eye-bolts, formerly referred to, are most useful for having them tightened up again. In the winter season, particularly during frost, the wire always contracts to a considerable extent, causing the wires to become over tight, and consequently in such cases they require to be slackened; and this I have experienced so often, that I think it proper to refer to it here; because if these points be not attended to, the wire will break in the winter and allow cattle to escape, and become too loose in summer.

276. From extended experience in the erecting of wire fences, I am now decidedly of the opinion that they should be all put up on iron straining-posts, properly secured into large stones sunk into the ground, and supported on both sides with strong stays, proportionate to the height of the fence. Wherever this mode has been adopted the fences answer admirably, both for strength, durability, and neatness of appearance. In fact, a fence put up on this principle may be truly said to be indestructible by time, if properly attended to and kept in order, as, although the intermediate posts of wood should rot and give way, the iron posts remain as they were when put up, and therefore the wooden posts of the fence can be easily repaired or removed at any time, when the whole will be as good as when new. A wire fence erected on iron straining-posts, and with wooden intermediate ones, I have found generally much stronger to resist heavy cattle and deer than one with the intermediates all constructed of iron. This arises from the intermediate posts of wire fences being generally made from comparatively slight dimensions of iron, when they are constructed of this material, and from cattle and other heavy animals bending and displacing them. I have no hesitation in stating, therefore, that the strongest wire fence that can be economically erected, is one on iron straining-posts, with strong wooden intermediate ones—as, erected in this way, it may be very properly termed a permanent fence. It is, however, often a matter of considerable advantage and economy for proprietors, who have really good, sound, and durable larch timber, to use it for the purpose of fencing; and having thus stated my opinion on the subject, I leave the choice of the use of wood or iron to parties as they may find the one or the other most suitable for their purpose.

277. Where wire fences not over four feet high are used as subdivisions

for parks in which horses are grazed, it is a very great improvement, both in point of strength and safety, to have a line of strong bars (wooden) fixed along the tops of the posts. I have seen this plan adopted where horses were apt to leap over such fences,—as they sometimes do, and get injured thereby,—and where they were in the habit of pressing much against the posts and wires. Such a line of wooden bars may be easily secured along the tops of the posts of a wire fence, by means of pins passed through the bars into the top of each post. Put on in this way, the bars could be easily removed when not wanted, or when the parks were to be grazed by sheep only, or during winter, when it might be considered judicious to lay them past for preservation.

SECTION X.—THE PURPOSE AND SITUATION FOR WHICH EACH SORT OF FENCE IS MOST PROPERLY ADAPTED.

278. Having now given in detail the method of erecting the most common and generally useful fences for country purposes—namely, the thorn hedge, the whin hedge, the stone-and-lime wall, the dry-stone dyke, the turf dyke, wooden paling, and wire fence both upon wooden and iron uprights, and also given a description of some of the plants used in hedging besides the thorn, beech, and furze—it still remains for me to point out in what situation, and for what purpose, each of the above-named fences is most suitable. In the present section I shall endeavour to do this; and shall commence with the first in order—namely, the thorn hedge.

279. For the subdivision of strong clay and heavy, loamy, arable lands, as well as for the enclosure of plantations in such districts, I do not think that any fence is so suitable, both in respect to neatness and duration, as the thorn hedge, as in such soils it lives long, becomes strong and healthy, and makes an admirable fence.

280. The thorn hedge, with a mixture of beech plants, is of all other fences the best adapted for a situation where a neat and clothed appearance is the object; and this it always has unless carried to a situation more than one thousand feet above the level of the sea, and unless at such an altitude planted in a mossy or very light soil; for there it will not live long unless upon a loam.

281. In high and exposed situations, hedge fences are not the best adapted for surrounding young plantations, which require a fence that will produce shelter in the first instance. They are, however, there excellently adapted for the division of fields; and even in such situations, where immediate shelter for the rearing of young plantations is not a primary object,

no fence ultimately answers better than the beech hedge; for such a fence, although on a light soil and high exposure, under good management, will keep good and be an ornament when dykes and palings of the same age are tumbling down and useless. I am aware that many object to the raising of hedges with beech and thorn in high parts of the country, asserting that the thorn does not succeed. As to this, I can assert thus far, that upon the estate of Arniston there are good hedges of beech and thorn more than nine hundred feet above the level of the sea, and at the same time in excellent health. In very high parts, however, and on very light lands, a better fence is secured by using beech alone, than by mixing with thorns, as the beech is not only hardiest, but better adapted to grow healthily in high lands.

282. I am not an advocate for planting hedges about the home-grounds and parks of proprietors' seats, because there they are in a considerable degree unsightly and out of character: there, in short, no fence ought to be prominent, and for these sites the wire fence is best adapted; but in all cases without the bounds of the policy walls, no fence looks better, or is more worthy of a prominent place, than the hedge, whether as a fence for a plantation or a field.

283. Second, The *whin or furze hedge* is unquestionably one which should be kept out of all cultivated districts. There is no situation where the whin is found growing as a fence, in which beech would not thrive much better. I am aware that many are of the opinion that whins are more hardy than most other hedge plants; but this I never could find. Upon the west coast of Scotland, between Portpatrick and Stranraer, I have seen the whins most severely cut down by a hard winter's frost, while other hedge plants were not in the least injured; and I have witnessed the same thing in the north of Scotland generally.

Whins for a hedge fence may, indeed, be recommended by those who have a regard for old customs, but in my opinion they are decidedly inferior in every respect to the thorn and beech: therefore, I in all cases recommend the latter plant in preference to them.

284. Third, The *stone-and-lime wall* is of all others the most substantial fence that can be erected; but as it is an expensive one, it cannot properly be carried to any great extent. However, no gentleman's policy grounds can be said to be complete, as regards general security, unless they be surrounded by a stone-and-lime wall of from six to eight feet high. In fact, a gentleman's park surrounded by a good high wall gives us a confident feeling that there is something within the bounds of it worthy of being protected; and we always find the best of seats surrounded by such. But in no other case is it necessary to erect a stone-and-lime wall as a

fence, unless in the case of sunk fences. In a former section, when referring to the making of sunk fences, I said that they were only adapted for a particular situation—namely, upon the slopes of rising ground; and by no means upon level ground, for there, if it is meant to have an invisible fence—as the sunk fence is meant to be—the wire fence is infinitely superior in every respect, and is now at the present day what sunk fences were a hundred years ago. A sunk fence is excellently adapted for any purpose whatever, when built upon the slope of a hill or brae, as shown in Section V.; but in any other, I am not aware of its utility.

285. Fourth, The *dry-stone dyke*, of all other fences, is the best adapted for giving immediate shelter to young plantations and other crops upon high and exposed parts of the country. Unlike any other fence, it is both a fence and a shelter at once; hence the reason that it is so much in request in all bare uncultivated districts. I have had frequent occasion to observe, that in high and much exposed districts, young plantations surrounded by a good dry-stone dyke were ten years in advance of others which had been surrounded by a young hedge with paling to protect it; therefore it is that in all cases upon high parts, where stone dykes can be had at all conveniently, I recommend them for young plantations, and for every other rural purpose.

I have heard many assert that it would be a great improvement to build dykes upon high situations altogether with lime, making them, in short, stone-and-lime walls; but I beg to observe that this would by no means be an improvement; for a dry-stone dyke will give more shelter to trees, or any other crop growing inside of it, than a wall of the same height built closely with lime. A dry-stone wall sifts the wind and softens its power for a great distance; whereas the wind striking upon a close stone-and-lime wall is at once resisted, and the consequence is, that the wind, when it rushes over the top of the wall, has gained strength, and strikes with greater force upon the ground beyond; and this is the reason that a hedge is in all cases a better fence than a wall for shelter: the hedge sifts and softens the force of the wind more than a wall of any kind does. Dry-stone dykes are, from their outlandish appearance, not to be recommended as a fence where a fine effect is meant to be kept up, therefore they should not be built near the home-grounds of a gentleman's property; but upon high-lying parts of the country, where improvements are in infancy, no fence is more commendable, both as regards security and shelter.

286. Fifth, The *turf dyke* is next in importance to the stone dyke, in high-lying districts, as a fence; that is to say, in so far as regards immediate effect in the producing of shelter to young plantations or land under any other crop. Upon Lord Seafield's estates of Strathspey, Cullen, and

Glenurquhart, we have a vast extent of turf dykes, chiefly as fences for young plantations. These fences, let it be understood, are upon the high-lying parts of the estates, where stones for a fence are not easily got; and, as a fence for the protecting of young plantations, I find them answer very well indeed. They should not be put up where heavy cattle are to be grazed alongside of them, for they are always inclined to burrow about them with their horns, which tends much to injure the fence; but in all cases where stone dykes are not easily attainable from the difficulty of conveniently getting material, and where heavy cattle are not grazed, they form a very good fence, and will last for a great many years by a little attention to mending when any break occurs.

287. Sixth, *Wooden palings* are, in general, only considered as temporary or assistant fences. In all cases where young hedges are planted, and where cattle of any description are to be grazed in the fields adjoining, they must be protected by a wooden paling until they have attained a size and strength sufficient to insure their being exposed with safety; and this is one use for which palings are in continual demand.

In high-lying situations, palings are not often used as a fence alone, because they produce no shelter; and where they are erected in such a situation, it is generally on those parts of the land where stones and turf cannot be conveniently got for a dyke, but they are highly useful as an assistant fence upon a turf dyke, or along the side or sides of a young hedge. In low-lying situations, however, where shelter is not deemed of great importance, the wooden paling is extensively used for all purposes, both as a useful and ornamental fence. The horizontal paling is used principally for agricultural purposes; such as the protecting of hedge fences in their young state, or for the mending of gaps in old hedges, &c.; but the upright paling, as well as an endless variety according to the taste of parties, are mostly used as ornamental fences about gardens, cottages, &c., and they form excellent and useful fences when made of good larch-wood, which will last longer than any other sort for this purpose.

288. Seventh, The *wire fence* upon wooden posts has often been recommended as a substitute for other materials where these are scarce; but I can by no means agree with those who recommend wire fences for young plantations or any field crop upon a high and exposed situation, where shelter is of primary importance. No fence is better adapted for ornament than the wire fence, therefore it is that I recommend it for all purposes without exception within the policy walls of a gentleman's property; and it may even be very properly extended beyond this where the estate is in a sheltered part of the country, and where artificial shelter from fences is of little importance; but as a fence where shelter is an object, the wire fence

is by no means to be recommended. Even where wood is scarce, the wire fence may very properly be used instead of palings upon the top of turf dykes; for this, if put on with good larch posts, will last much longer than any common paling could do. Where the greatest possible degree of invisibility is wanted, as well as the greatest possible degree of permanency as a fence, the wire fence upon iron uprights is to be used; and this sort, when painted green, and as near the shade of the grass as possible, is not observable by a person till within a few yards of it; but where heavy cattle are—unless, indeed, the fence is constructed upon a very strong scale, and of course this can always be done—the fence upon wooden uprights is preferable, because the iron uprights, if at all weakly, are very apt to bend and be misplaced when a heavy animal comes in contact with them, while the wooden uprights are not apt to be in the least disturbed from this cause.

289. Having said thus much relative to the sorts of fences in most common use, both for the protection of young plantations and fields under agricultural cropping, I may further state, relative to plantations in particular, that the proprietor who plants extensively must judge for himself how far he is to adopt one sort of fence in preference to another. This of course must always be decided by the nature of the soil and situation, and the convenience as regards materials; observing in all cases to erect a fence that will combine shelter with durability upon high and exposed situations; and where the situation is low and naturally sheltered, the taste may more reasonably be consulted. In all cases of fencing for the protection of young plantations, the work should be particularly well done; for if it be badly executed, and a part of the fence be broken down by any slight accident, cattle may get in, and do more damage in one night than could be well recovered in the course of years. This I have experienced so frequently, that I here beg to advise all proprietors to be most strict in the executing of such work, where, in fact, no small part of the wealth of their estate is at stake. In the case of erecting stone and turf dykes by contract, as is the general way of having these done, the contractor should be bound to keep his work good for at least three years after it is finished. Under this engagement he will, for his own sake, be anxious to do his work well.

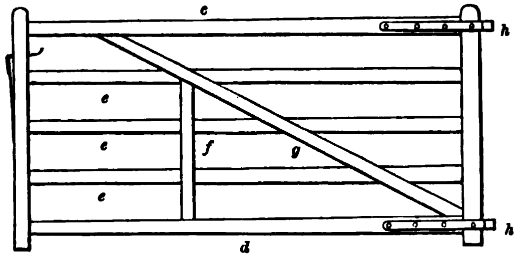
290. All wooden palings should be erected by the proprietor's own people upon the estate; as also all wire fences, if possible, and the planting of hedges; and it is for the gaining of this end that I have written the above observations on the erecting of fences, that every forester may be as nearly as possible a competent erecter of fences.

SECTION XI.—THE MAKING AND HANGING OF GATES UPON FIELDS AND PLANTATIONS.

291. As the making and hanging of gates is a branch of rural economy most frequently devolving upon the forester, I consider it necessary, and of importance, to dedicate a section to the explanation of the most approved method of making and hanging field and plantation gates; and moreover, having said so much upon the nature of fencing in general, this chapter would be incomplete without a few observations on this point.

292. Every field and plantation of any consequence must have one or more entrances into it, in the form of one or more openings in the fence which surrounds it, and which again must be made to act either as a fence or as an opening as occasion may require. These openings are termed gateways; and whatever may be put upon them to act as a fence is termed a *gate*. There are many forms of gates in use in different parts of the country, from the most rude horizontal spar, made to fall into a post at each end, to the fine massy iron gate hung upon hinges. It would be entirely out of place for me here even to attempt to enumerate the many different sorts of gates that may be considered of useful designs; I shall, therefore, confine myself to the description of one sort of field-gate, which is also, in my opinion, the best possibly adapted for a plantation-gate, and which I consider the most complete for all field and plantation purposes. Fig. 39 is a sketch of the gate referred to; upon the estate of Arniston all gates, both upon field and plantation fences, were made of this construction, and since coming to Strathspey, I have introduced them there also. These gates are all made of the best old larch-wood, or the best old pine, which, when painted, lasts for a great number of years. As larch-wood, however, is very apt to twist in the heat of the sun, to which it is exposed when converted into a gate, it ought to be well seasoned before being used for this purpose. The following are the dimensions of the gate referred to in Fig. 39. The back post *b* is five feet high from bottom to top, and the scantling four and a half by two and a half inches. The front post *a* is also five feet high from bottom to top, and the scantling three by two inches.

FIG. 39.

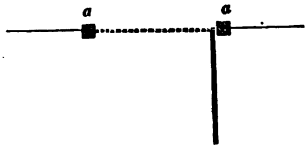


The bottom and top horizontal bars *c* and *d* are each of equal dimensions—namely, length within the back and front posts about nine feet. These are four inches broad at the joinings upon the back-post *a*, and three inches broad at the joinings upon the front-post *b*, by two and a half inches thick. The horizontal intermediates *e e e* are of course of the same length as the bottom and top bars, and of the same breadth, but they are only one and a half inch thick. The diagonal bar *g*, which reaches from the heel of the gate to within two feet of the point of the top bar, is of the same strength as the upper and lower bars, and, like them, tapering from four inches at heel to three inches at point; and the upright piece *f* is of the same dimensions as the intermediates, and reaches from the bottom bar to the diagonal at its junction with the second bar from the top. This gate is furnished with double hinges, which greatly strengthen the back part by clasping the joints both at bottom and top, *h h*. See Fig. 40, which is a representation of this double hinge. The peculiar properties of this form of gate are, first, the back-post *b* is much heavier than the front one *a*, which tends to throw the centre of gravity upon the hinges; second, all the horizontal bars, from bottom to top, are made heavier behind than in front, and all with the intention of lightening the gate in front, and throwing the centre of gravity as much as possible upon the hinges; and, third, the diagonal, *g*, is so placed that it acts completely the part of a lever against any weight that may be thrown upon the front part of the gate; and even its being lighter as it recedes from the heel, is a great means of supporting the whole of the gate, and of keeping it in a well-balanced state. It appears to me, that any gate made upon these principles must approach the model of perfection in such a structure; and it is upon this account that I consider the gate now described to be of the best description possible, seeing that it combines strength and lightness in a very perfect manner. In making the description of gates mentioned, it is necessary, in order to have them to last as long as possible, to have them very neatly jointed, planed smoothly, and painted with two coats of oil-paint before being hung; and even after they are hung in their place, they are much improved by being painted at least once in three years. The wood and workmanship of a gate of this description may be valued at 10s.; the hinges generally weigh about 20 lb. weight, which, at 4d. per lb., will be 6s. 8d. additional; making the entire cost of the gate with iron mounting, 16s. 8d.

FIG. 40.

293. I now come to make a few observations upon the nature of hanging gates upon fences, both in fields and plantations; and as I have frequently seen a great deal of error committed in this branch of the business of fencing, I shall state the manner in which we hang our gates, which is considered by all who have examined it an excellent way of doing the work. The common way of erecting gates is to hang them right between the two posts put up for the purpose; and by this method, when the gate is set open, it stands at right angles with the fence upon which it is placed (see Fig. 41, *b*); consequently it is in this state always liable to be injured by carts, &c., coming in contact with it when going into or returning out of the field or plantation. Another evil which almost invariably attends this old-fashioned method of hanging gates is, that from being hung from centre to centre of the two posts, as indicated by the dotted line between the two posts *a a*, when anything goes wrong with either, the gate must be left too slack or confined too tight between them, according to the direction in which the post may have been driven,—consequently the gate has a great chance to be injured in some way or other; besides, the posts are seldom put into the ground with the addition of any simple fixture whatever, being merely put into a hole, and the earth again beat down about them; and, from this circumstance, if the earth has been put in about the posts in a wet state, the certain consequence is that they become slack in a short time, when the gate falls down in front, and, in consequence of coming in contact with the ground, is soon either broken or much injured in the joints. Having seen this often happen from bad management, I here recommend the following method of hanging plantation and field gates: Let the post upon which the gate is to be hung be pretty strong—say eight inches on the side of the square, and let the part of it which is to be put into the ground be left round, with the bark upon the wood, and have it put into the ground two and a half feet deep, and fixed upon a sole with a diagonal or stay, as has been already advised for wire-fence posts. Having the post made with its sole and stay on the under part, put it into the hole prepared for it, with the sole and stay projecting in the direction of the gateway, which will insure its stability against the weight of the gate or any other ordinary pressure in that direction, and have the post well firmed into the hole: if the earth taken out be of a soft nature, keep it out, and fill up the pit with small stones mixed with earth, or any other thing of a hard and binding nature; and be most particular not to fill in with earth in a soft or wet state, else the work will be insufficient, and will not give satisfaction. The post upon which the gate is to be shut may be considerably smaller, if thought necessary, than the other: it will not require to have any sole or stay attached to it, but may very safely be put into the earth at the same depth recommended

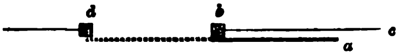
Fig. 41.



for the other; observing to make it equally as firm, putting a very large stone or two into the pit near the surface, which will add much to the stability of the post.

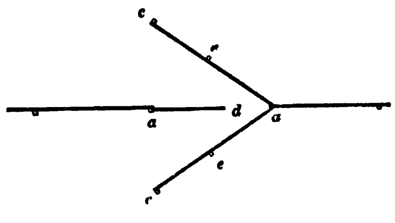
Having put the posts in plumb, and at the desired distance, which should always be the exact length of the gate to be put on, next have the *crooks*, upon which the gate is to be hung, put into the post on the angle of the same, instead of on the centre as in the former case. See Fig. 42, where the gate *a* is hung upon the corner or angle of the post *b*; the effect of this being that the gate, when hung in this position, has full play upon the hinge to fold back upon the fence *c*, and is not hindered in its motion by the corner of the post, as is the case in the other method; consequently, from the gate having room to fall back upon the fence, it is, when open, entirely out of the way of any cart coming into or going out of the field. Next, instead of the gate being made to shut right between the posts, it ought to be shut upon the face or outside of the shutting-post *d*; this is represented by the dotted line, which shows the position of the gate when shut: and in this case, whatever accident may befall the post upon which the gate shuts, the gate cannot itself be injured. The upper crook of all gates of this description should be made so long as to go through the post, and have about two inches of a screw upon the end of it, upon which a large nut, made to fit, is screwed; by this means the crook will keep its position, and will cause the gate to do the same.

FIG. 42.



294. It is often found convenient to have small wickets upon certain parts about gentlemen's grounds, particularly upon the edges of plantations through which pleasure-walks are made; and as it is frequently inconvenient to have such wickets to open and shut in the same manner as common gateways, it is desirable they should be constructed so as to be what may very properly be termed *self-shutting*. Of this description of self-shutting wickets I know of none more simple and effective, both as a fence and a gate, than that shown in Fig. 43, which is generally termed the angular wicket. The opening in the fence, from *a* to *a*, may be about four feet wide; the angular part of the wicket, *a c c*, may be about three feet wide between *e* and *e*, and may be made up with any convenient sort of wood, according to taste; observing to have a post upon each of the extremities, and one at *e* upon each side, in order that the wicket, *a d*, may hit upon one

FIG. 43.



as it folds to either side in the act of opening or shutting. The wicket *a d* may be made of light wood, and hung with a hinge upon a post at *a*. The particular properties of this sort of wicket are, first, that it is of a most simple and easy construction; second, it is easy for any person to have access through it, and that without the trouble of shutting or locking; and, third, whatever description of cattle may be in the adjoining fields, they can have no access through, seeing that if they do attempt it, the wicket as they go in shuts upon the opposite side before them.

CHAPTER III.

SECTION I.—PREPARING OF GROUND FOR THE GROWING OF YOUNG TREES.

295. Many practical foresters have maintained that all ground, previous to its being planted with young forest-trees, ought to undergo a course of preparation by trenching, digging, or ploughing, and by having lime or manure in some way or other applied to the land, if of a poor description. Such a course of preparation as any of the above may be very proper in some cases, but it is attended by the very worst effect in others. As I have been, and still am, very often questioned by proprietors relative to the utility of trenching, digging, ploughing, or manuring of land previous to its being put under a crop of young forest-trees, I shall here give an example or two from my own experience upon these points, with a few observations upon each head.

296. When I went to act as forester at Craigston in Aberdeenshire, I found that some parts of the old woodlands, from which a crop of old and matured pine and fir timber had been lately cleared, were trenched in the common way, and had again been planted with a crop of trees of various sorts about four years previous to my going there.

The ground which had been thus trenched was situated in a pretty sheltered part of the estate, and mostly surrounded by old plantations: consequently the situation was one rather favourable for such an experiment. Upon examining the nature of the top and sub-soils, I found the former to be a dry sandy moss, well mixed with fresh vegetable matter, and in all from six to ten inches deep; the subsoil was a tilly gravel of a dark-brown colour, frequently several feet deep, and resting in many places upon a hard freestone rock of a reddish colour, and in others upon a deep bed of pure gravel. In the act of trenching this ground, the surface had been pared off and thrown into the bottom of each opening, and covered by about a foot of the subsoil: where old roots had been taken out, the trenching was no doubt in those parts deeper, but, on an average, the trenched ground might be said to be twenty inches deep.

I said that this ground had been planted with another crop of trees about four years previous to my going there, and the kinds planted were ash, elm, Scots pines, and larch firs. When I first saw this crop of young trees upon the trenched ground, they looked as if they had been planted only the previous year. They were alive, but had made no considerable shoots of young wood since they had been planted: and upon learning the nature of their situation, I had the hardwood all cut over; but this of course I could not do with the firs, consequently I allowed them to do their best with the circumstances under which they were. I watched the progress of those trees minutely during the two years that I was on that place. The hardwood set up two or three sickly young shoots from each stock; but during the time I was there I found them very little improved, the whole of the plants remaining in a languid state. The firs were in a state very little better than the hardwood. When I first went to the place, I had the ground made up with many fresh plants of the fir tribe, because many blanks had occurred; and after watching their progress for two summers, I found that those which had been in the soil for six years were only making annual shoots of about two inches, and those that I had myself planted upon the same soil, being two years in the ground, had scarcely made any wood whatever.

297. As I had occasion to plant a few acres on a cleared part of the same old plantation the first year I went to Craigston, I planted it with an intermixture of oak, ash, and elm, Scots pines and larch firs; but instead of trenching the ground, I planted them on the surface, and in the usual manner; and before they were twenty months in the ground, those trees were far superior to the others which had been six years planted.

298. Upon the estate of Dunskey, in Wigtownshire, the property of General Hunter Blair, there was a tract of ground trenched for a young plantation on a high and exposed part of the estate, and within one mile and a half of the sea. When I examined it, I learned that the trees had been planted upon it about six years; yet, generally speaking, they were not more than ten inches high, and standing at very wide distances. The greater half of the trees planted having died out, and the proprietor finding it a hopeless task, had abandoned the attempt of growing trees upon the ground; and in this state I found them.

The ground was a very light, sandy loam, resting upon a rough gravel of considerable depth, and it had been trenched much in the same manner as in the former case. The consequences were apparently much the same in the one case as in the other; that is to say, the trenching of the ground in both cases disappointed the views of the proprietors. Here, now, we have two examples of trenching ground for young forest-trees both attended with bad effects, and I vouch for the truth of both the examples given. The blame could not be attributed to the soil itself, seeing that trees grow well upon the same nature of soil when planted on the natural surface: the failure was altogether attributable to the trenching; for the best of the soil was thrown undermost in the act of trenching, and the bad soil brought up in both cases; but had this soil been simply trench-ploughed, and the top and sub-soils mixed together and allowed to rest for a year or two, the results would no doubt have been very different. These two examples have quite determined me as to the effects of trenching light land for young trees upon any situation; and in no case of forest management do I ever attempt trenching, knowing that the young trees are more sure of doing well when planted in the soil in its natural state.

299. Allowing that those who advocate the trenching of forest land have in many instances been so far successful in their management, upon a good and heavy description of soil, as to grow trees rapidly, the expense necessary to be incurred is too important a point to be passed over.

It is evident that, however much good might arise to trees from the trenching of the ground upon which they might be planted, it could not in practice be carried to any useful or great extent. In ordinary cases, land cannot be trenched under £8 an acre; and where trees have been formerly, and huge roots have to be taken out of the ground, even £15 an acre would not be too much for the trenching of ground in such a condition. Therefore, in general practice, it is entirely out of the question.

300. The trenching of ground as a preparation for young trees may be very proper, and even necessary upon a small scale, near or about a proprietor's policy grounds, in a good heavy loamy soil, and in a sheltered situation, particularly where large trees may have been newly taken down, and where, for the sake of appearance, it is desirable to have old roots taken out previous to replanting; but it is only in such a case that trenching, in my opinion, ought to be recommended in the cultivation of forest-trees, and even then, only if the subsoil be naturally good. There is no advantage gained by the trenching of ground for forest-trees which is not decidedly better attained by a well-conducted system of drainage.

301. The *ploughing* of land has been much recommended as a preparation of the ground for young trees. In my opinion, where the subsoil is naturally open and easily drained, there is no necessity for the ploughing of it previous to its being planted; but where the upper stratum of soil is naturally thin and poor, with *moorband-pan* under, a deep ploughing is absolutely necessary, in order to break the pan and mix a portion of the subsoil with the upper. The fact is, that a soil of the nature of moorband-pan is naturally unfit for the growing of forest-trees; but where the proprietor of such a soil, in the general arrangement of his improvements upon

his estate, may wish to plant such a piece of ground with forest-trees, the trench-plough must be used in order to open up the soil and break the pan. Deep drainage will, however, in time answer the same purpose, as from its action the moorband-pan is gradually removed, but in order to this, the land must lie from five to ten years under its influence; whereas, when such land is first drained, and trench-ploughed immediately after, trees may be planted on it one year afterwards with every hope of success. I am not aware that ploughing is advantageous to the growth of forest-trees in any other case. I am aware that *pine* and *fir-trees,* planted and growing upon land which has been frequently ploughed previously, seldom live long or attain to any considerable size free from disease, which at once points out that nature wishes no interference of the kind. Some years ago, when passing along the Lammermoor Hills in Berwickshire, my attention was much engaged by observing a young plantation at a distance having a strange chequered appearance; and when I came up to it and examined the cause of such an appearance, I found that each five yards in breadth of the ground had been ploughed previous to the trees being planted, and other five yards in breadth left unploughed alternately. It appeared to me that the trees had been planted about seven years, and they consisted entirely of larch and Scots pines. Those on the ploughed land were about five feet high, and those on the unploughed were not more than two and a half feet. In the unploughed land, the Scots pines were proportionally stronger than the larches; and upon the ploughed parts, the larches were by far the strongest, and had made generally great progress, the situation being very high and exposed—more than a thousand feet above the level of the sea; and the Scots pines giving a dark colour to the unploughed ridges, and the larch firs giving a light colour to the ploughed ones, was the cause of the appearance which first attracted my attention and led me to examine the plantation.

Here, now, we have an example of the effects of ploughing land for the reception of young trees; and it is decidedly remarkable, in the first instance, as compared with trees grown on the natural surface. In this case, the trees upon the land which had been ploughed were twice the height of those planted upon the unploughed; and it is the same in almost all cases of ploughing moorland for forest-trees: this is occasioned by the decomposition of the grassy turf, and also by the roots of the plants having free and unchecked scope for the spread of their roots in search of food, which they cannot so readily do when the turf is of a close and compact nature, and in an undisturbed state. Upon all the woodlands that I have examined, I have had occasion to observe that wherever the land had been under the plough previous to its being planted with trees, the wood there is of greater dimensions in a given time than it is where the trees had been planted upon the undisturbed soil; but it is not nearly so sound in quality, and does not live nearly so long, more particularly the larch and pine timber. Therefore, from my own experience, I beg to say that all artificial cultivation of the soil ought to be avoided where it is desirable to have healthy and long-lived timber trees; for the quicker that any sort of wood is made to grow, the softer is its structure, the more liable to become decayed, and the less really valuable the timber.

302. Liming and otherwise manuring the soil for young trees has been recommended by some and disapproved of by others. In my opinion—and I speak from experience—all artificial excitement of a young tree by the application of manure is ultimately injurious to it. I have seen small plantations grown upon the system of trenching, liming, and otherwise manuring; and in such cases I have generally had occasion to observe that the trees grew rapidly for a few years at first, but as soon as the exciting influence of the manure had begun to fail, the trees fell into a bad state of health, and seldom attained that confirmed state of maturity which is found when Nature has her own way. However, I am not prepared to say as to what state of perfection trees might grow were manure added to their roots at stated intervals; nor do I think it necessary that we should know the results of such a system of management, seeing it would be of no real use to grow trees upon such an expensive system, and one which would in all probability cause the timber so raised to be of a soft and inferior quality.

303. To conclude this section, I have to state that, whatever be the nature and character of land—whether it may be clay, heavy loam, light loam, sand, or gravel—whether it may be situated on a high and exposed part of the country, or on a low-lying and sheltered district—it requires no preparation for the growth of trees other than a well-conducted system of drainage. This put properly into operation—if the land is not at an altitude too high for the healthy development of any of our known trees—a crop, and that a good one, of some sort of tree will grow upon it, according to its texture. I give this as the result of nearly thirty years' experience in the raising of plantations upon all descriptions of land, from that only a little above the level of the sea, to that about 2000 feet elevation. In short, I have not yet failed to grow a crop of healthy trees upon any description of land, whatever may have been its former condition, by a proper application of drainage, and by a proper selection of the plants in accordance with the soil and situation.

SECTION II.—SHOULD LAND BE REPLANTED WITH YOUNG TREES AFTER HAVING GROWN A CROP OF TIMBER?

304. I am not aware whether any well-conducted courses of experiments have ever been made in reference to this branch of arboricultural knowledge, which is to be regretted, as there are few points in forestry on which practical men are at greater variance, or on which they are less able to give sound and satisfactory proofs for or against. I shall, therefore, give my own opinion generally on the subject.

305. Many have stated to me that a crop of pine or larch will not succeed satisfactorily on land that had been formerly under a crop of the same sort of trees, and on which they had become matured, and the reason invariably given for this is, that the former crop had exhausted the land of the proper food for a second of the same kind. In this statement, taken as it stands, there is certainly much of truth, but there is also in it much that is erroneous, and which, in consequence, leads to false conclusions. The statement is, generally speaking, true, in respect to the growth of larch and pine on lands lying on the limestone and freestone formations, as these do not constitute the soils adapted to the most healthy development of the trees under notice, nor those on which we generally find them in a state of nature; while the statement is in error when applied to the growth of the larch and pine on lands lying on the granite rocks; and it is from not considering the question in geographical and geological points of view that false conclusions have been arrived at on the subject.

306. On the low-lying and table lands of the south generally, and apart from the hilly and mountainous districts of the country, I have seldom seen, except under peculiar circumstances, larch and pine succeed to any great weight of timber in a sound state when planted as a crop on land that had been before occupied by trees of the same sorts; while, on the granite districts of the north, I could point out vast tracts that have produced a second and even a third crop of these trees, each successive one seemingly as healthy as the one before it had been.

307. In our natural pine forests in Strathspey, crop has succeeded crop seemingly for thousands of years, and still that growing in them at the present day seems as good, healthy, and large as that we find lying in the mosses, and which is the remains of crops that had stood and grown on the same land many centuries ago. Notwithstanding all the successive crops of pine that have grown on these forests, even at the present day, whenever a portion is sufficiently cleared of old trees to admit of air and light penetrating into the soil, we find a race of young and healthy plants

rise up thickly all over; thus indicating that successive crops of the same tree will grow each as healthily and as luxuriantly as another on the same piece of land, provided always that the kinds used are planted in the land naturally adapted to them. I repeat, therefore, that in order to grow trees upon any piece of land, it is only necessary to do the work on the principles that nature has pointed out to us—viz., in accordance with the geographical distribution of plants.

308. I am of opinion that there is no description of land on which successive crops of trees may not be grown, provided we attend to the rule laid down in the last paragraph; and that it is the neglect of applying to forestry this sort of knowledge that is the cause of failures in planting generally, whether the land may have been formerly under a crop of trees or not.

309. I am myself in the habit of planting larch after larch, pine after pine, oak after oak, and so on, in all cases where I find the land naturally adapted to their healthy growth; and as to how I have succeeded in this, I leave the result to prove.

310. On clays and on heavy loamy soils, successive crops of the different species of hard-woods may be grown, while on the light and sandy loams of the hilly districts—not lying on sandstone or limestone—crops of larch and pine may be raised successively. On the heavy lands adapted to hard-woods, larch will grow and arrive at good result, although made to succeed a crop of hard-woods, but I cannot say that the pine will succeed so well under the same circumstances—at least, I have not found it do so.

311. Whatever species of tree a piece of land formerly under timber may be found suitable for, it is vastly improved by thorough drainage, although it may seem quite dry in the ordinary sense of the term dryness as applied to land, more especially if its site be of a flat character, and without the means of natural drainage.

312. The character of land is generally much altered, and that for the better, after undergoing thorough drainage; and this more especially holds good in respect to such land as has borne a crop of old timber, and on which a large quantity of decayed vegetable matter rests. It is well known that the operation has the effect of cleansing the land of many ingredients hurtful to the growth of plants, and of making it wholesome and fit for species which, before the operation, it would not support in health at all.

313. Any piece of woodland cleared of a crop of matured timber may be made available for the growth of another crop, either of the same sort, or of another, as may be found most suitable, by—1*st*, burning and otherwise clearing every portion of the refuse of the old crop; 2*d*, by destroying the bark of the old stools left in the ground, so as to prevent lodgment for

beetles and the growth of young roots from them; 3*d*, by cleansing by drainage all flat parts, although seemingly dry; 4*th*, by allowing it to rest for a period of four or five years after these operations; and, 5*thly*, by adapting the young crop to the land as already explained.

314. A change of crop is often absolutely necessary on woodland, in order to ensure entire success in replanting it—as where a crop of oak has been grown on very light, and therefore unsuitable land, a crop of larch and pine will succeed admirably; and where a crop of larch has been grown to maturity on land of a heavy description, hard-woods will succeed well if drainage be properly applied, so as to cleanse it from any bad qualities left in it by the debris of the larch.

SECTION III.—DRAINAGE GENERALLY CONSIDERED AS A MEANS FOR THE IMPROVEMENT OF LAND.

315. Professor Johnston, in his very able *Lectures on Agricultural Chemistry and Geology*, states, in reference to the physical qualities and chemical constitution of the soil, that "man can alter both its physical qualities and its chemical constitution, and thus can fit it for growing other races of plants than those which it naturally bears; or, if he choose, the same races in greater abundance and with increased luxuriance. It is, in fact, in the production of such changes that nearly all the labour and practical skill of the husbandman—apart from local peculiarities of climate, &c.—is constantly expended. For the attainment of this end he drains, ploughs, subsoil-ploughs, and otherwise works his land. For this end he clays, sands, marls, and manures it. By these and similar operations the land is so changed as to become both able and willing to nourish and ripen these peculiar plants which the agriculturist" or arboriculturist "wishes to raise. It is a matter of history that Charlemagne hunted in the forest of Gerardmer, then consisting of oak and beech, though now the same forest consists only of pines of various species. In the Palatinate, the Scotch fir (*Pinus sylvestris*) is also succeeding to the oak. These facts not only show how much the vegetable tribes are dependent upon the chemical nature of the soil, they indicate also the existence of slow natural changes in the constitution of the soil, which lead necessarily to a change of vegetation also. We may, therefore, take a practical lesson from the book of nature. If we wish to have a luxuriant vegetation upon a given spot, we must either select such kinds of seeds to sow upon it as are fitted to the kind of soil, or we must change the nature of the land so as to adapt it to our crop. Let us now turn our attention, therefore, to the methods by which

these beneficial changes are to be effected and maintained. Among the merely mechanical methods by which those changes are to be produced upon the soil, that are to fit it for the better growth of valuable crops, draining is now allowed to hold the first place. It may be useful, then, briefly to state the several effects which, in different localities, are likely to follow on efficient drainage of the land: 1*st*, It carries off all stagnant water, and gives a ready escape to the excess of what falls in rain. 2*d*, It arrests the ascent of water from beneath, whether by capillary action or by the force of springs; and thus not only preserves the surface soil from undue moisture, but also frees the subsoil from the lingering presence of those noxious substances which in undrained land so frequently lodge in it, and impair the growth of deep-rooted plants. 3*d*, It allows the water of the rains, instead of merely running over and often injuriously washing the surface, to make its way easily through the soil. And thus, while filtering through, not only does the rain water impart to the soil those substances useful to vegetation, which it always contains in greater or less abundance, but it washes out of the upper soil, and when the drains are deep enough out of the subsoil also, such noxious substances as naturally collect and may have been long accumulating there, rendering it unsound and hurtful to the roots. The latter is one of those benefits which *gradually* follow the drainage of land. When once thoroughly effected, it constitutes a most important permanent improvement, and one which can be fully produced by no other available means. It will be permanent, however, only so long as drains are kept in good condition. The same openness of the soil which enables the rain to wash out those soluble noxious substances which have been long collecting, permits them to carry away also such as are gradually formed, and thus to keep it in a sound and healthy state; but let this openness be more or less impaired by a neglect of the drainage, and the original state of the land will again gradually return. 4*th*, This constant descent of water through the soil causes a similar constant descent of fresh air through its pores, from the surface to the depth of the drains. When the rain falls, it enters the soil, and more or less completely displaces the air which is contained within its pores. This air either descends into the drain or rises into the atmosphere. When the rain ceases, the water, as it sinks, again leaves the pores of the upper soil open, and fresh air consequently follows. It is, in fact, sucked in after the water, as the latter gradually passes down to the drains. Thus, where a good drainage exists, not only is the land refreshed by every shower that falls—not only does it derive from the rains those important substances which occasionally, at least, are brought down by them from the atmosphere, and which are in a great measure lost where the waters must flow over the surface—but it is supplied also with renewed accessions of fresh air, which experience has shown to be so valuable in promoting the healthy growth of all our cultivated crops. *5th,* But other consequences of great practical importance follow from these immediate effects. When thus readily freed from the constant presence of water, the soil gradually becomes drier, sweeter, looser, and more friable. The hard lumps of the stiff clay lands more or less disappear. They crumble more freely, offer less resistance to the plough, and are in consequence more easily and more economically worked. These are practical benefits, equivalent to a change of soil. *6th,* With the permanent state of moisture, the *coldness* of many soils also rapidly disappears. The backwardness of the crops in spring, and the lateness of the harvest in autumn, are less frequently complained of, for the drainage in many localities produces effects which are equivalent to a change of climate."

Having given this quotation on the subject from a highly esteemed work, and as it exactly expresses our own views in regard to the benefits derivable from drainage, I think it unnecessary to add any remarks to it.

SECTION IV.—DRAINING AS APPLICABLE TO ARBORICULTURE.

316. Although the application of drainage as a means of improving and renovating the soil for agricultural purposes is now pretty well understood and appreciated in this country, still this cannot be said in regard to its application for arboricultural purposes; as a comparison of the state of the land under farming, with that under plantations, affords evident proof. Notwithstanding this, the benefits resulting from thorough drainage are as certain in the one case as in the other, although a greater length of time is necessary to prove its beneficial effects on a crop of trees than on one of corn; and from this proprietors of woodlands have been slow to expend much money upon their drainage. In respect to drainage, it may be generally stated that the woodlands of this country are at the present day very much in the condition that agricultural lands were some forty years ago.

317. Drainage, as applicable to arboriculture, is necessarily a very different operation from that usually practised for farming purposes; inasmuch as the plants grown in the former case are of a strong and permanent character, and send their roots down into the earth deeper and deeper every year successively, till their maturity is attained; while the plants raised in the latter case are mere annuals, with soft and perishing roots, generally dying—with the exception of the grasses—within a few months after they are sown.

318. For the reasons just stated, drains made on agricultural fields are properly covered up and hidden, both in order to keep the material of which they are made from accident, and to secure all the breadth of land possible for farm cropping; while those made on woodlands are with equal propriety left open, as they would, generally speaking, be gradually rendered inoperative by the descent of the roots of the trees into them in search of moisture.

319. Drainage, where it has been properly applied to agricultural land, has been the means of improving the produce to an extent which formerly could not be credited; and if it has thus increased the revenue of both the proprietor and the farmer, it is only reasonable to suppose that if it were comparatively as extensively and as judiciously applied to arboriculture, it could not fail to be the means of increasing the value of its produce in an equal degree. In proof of this I could point out large districts of wet land which had been planted with trees sixty years—before the advantages of drainage were understood—but which failed to succeed, now under a new crop of trees, in the most promising condition, simply from having been drained.

320. Drainage, then, where properly applied to the rearing of trees, is as advantageous to the increase of their produce, as it is to that of farm cropping. Therefore, as it is the very first step in agricultural improvement, it is equally so in arboricultural, and indeed in all the departments of rural economy.

SECTION V.—DRAINING OF LAND FOR THE GROWTH OF TREES PRACTICALLY DESCRIBED.

321. I have already hinted that there is no preparation of the soil so advantageous to the health of young forest-trees as draining, as it not only dries the soil from all superfluous moisture, but also cleanses it of many bad ingredients, which might otherwise prove injurious to them, and prevent their full development. To the want of draining may be attributed most cases of unhealthiness in plantations for forty years past. The diseases in the larch, which have been so prevalent in this country for some years past, may be almost entirely ascribed to the neglect of this precaution, as shall be particularly explained when I come to treat upon that subject. I have, within these last twenty years, seen very many plantations in Scotland and in the north of England fast going back from the want of draining; and having been often called upon to give my opinion relative to the unhealthy state of such plantations, I have, in almost all cases, found wetness to be the principal cause, and therefore recommended an efficient

course of open draining as the only means by which they could be recovered; and wherever my plan for the recovery of the health of such plantations has been put into operation, restoration has been the result, excepting in some cases where the trees were too old and stunted to indulge any hope of their recovery. On the estates, of the woodlands of which I have had the management, I have, by draining alone, brought several young plantations into health, which before that operation were fast going back; and from experience I find, that if the constitution of trees under twenty years old be not too much injured by the effects of dampness, they will show signs of recovery the second year after the ground is drained about them; that is to say, as soon as the young roots begin to draw nourishment from the dry and improved soil.

322. Thirty years ago it was considered superfluous to drain land where young trees were to be put in; therefore it is not to be wondered at that we have at the present time so many unhealthy young plantations. During my apprenticeship I have planted young trees in ground where, when I made a pit for a young tree, I had to plant it immediately, for fear of the pit filling with water; yet the person who had the management did not appear to think that draining was necessary. And such was the case with foresters generally at that time. However, the foresters of that period are not to be blamed for not draining their ground previous to its being planted, any more than farmers were to blame for the same neglect before they became aware of the advantages of draining. But the case is altogether different now. Every farmer and forester is now aware of the advantages of draining land, whether it may be for the growing of corn or of trees; yet we have often occasion to see this knowledge taken no advantage of, both among farmers and foresters.

Any farmer who now sows his fields without first draining them, is by his more intelligent neighbours considered unworthy of holding his land; so, in like manner, the forester who would attempt planting a piece of ground naturally wet, without first having it thoroughly drained, would certainly be unworthy of holding a situation as forester in any gentleman's establishment.

323. The land intended for a new plantation being all well fenced, the next important step to be taken, in order to fit it for the reception of young trees, is draining it, which draining must be executed in such a manner as to free the land from all superfluous moisture, and to keep it in a clean, open, healthy state. I may here remark, that all drains made in plantations among trees, whether these may be old or young, ought to be left open. The case, however, may be different in regard to trees of the pine and fir tribes, as the roots of these sorts do not penetrate very deeply; but

of this I am not yet prepared to speak decidedly, as my experiments on the subject have not yet been in operation a sufficient length of time to satisfy myself as to their results. I may state, however, that I am of the opinion that the roots of the pine and fir tribes do not generally penetrate so deeply as to interfere with drains as usually made on agricultural land, if they are not less than four feet deep. To cover drains where the roots of hard-wooded trees have access to them is the most effectual way of ultimately rendering them useless. They might, indeed, answer the purpose for a very few years; but as soon as the roots of the trees began to spread themselves firmly into the soil, they would collect about the drains more than any other part, and the consequence would be, that in a very short time covered drains would be entirely choked up with the roots, and rendered useless.

324. It is seldom found necessary to drain every part of the ground that may be laid out for a new plantation. There are, it is most reasonable to suppose, many parts quite dry enough for the rearing of healthy timber trees in almost every district of any considerable extent, which parts the experienced eye can at once detect by the general appearance of the plants growing upon the surface; but for the guidance of those who may not have had experience enough for this purpose, it may be necessary here to lay down something like a rule, by which they may distinguish land in want of draining from land not requiring it. Attention to the following hints will guide the forester: At certain distances throughout the whole of the intended plantation, say at twenty yards, cast pits rather more than twelve inches deep: if in those pits water should appear to gather within ten hours after being made, the land there is unfit for the growing of healthy trees without being drained; and where no water appears in the pits, the land there may be reckoned dry, and may be safely planted with forest trees without draining. This mode of ascertaining whether land requires to be drained or not, may answer very well as a guide for the inexperienced when the land to be operated on is of small extent, but where it is extensive—perhaps from five hundred to one thousand acres—it would be a useless waste of time to make pits over it all at the distances stated; while the natural state of the land in regard to wetness or dryness may be equally well known by attention to the kinds of plants growing naturally upon it. Several of the rough sorts of grass grow only on land that is wet in the subsoil, such as the *tufted hair-grass* (*Aira cæspitosa*). The rushes, also, (*Juncus conglomeratus*, and *J. effusus*), grow only on wet land, therefore draining is always necessary where they are found. Another plant always indicating wetness in the subsoil where it is found growing, is the *Luzula*, or *glow-worm grass*; and there is also the *Narthecium ossifragum*, which

is always an index of extreme wetness of the land. But, besides those named, there are many plants which point out to the observant eye the state of the land in regard to wetness, such as the mosses generally, and many of the lichens. In order to judge correctly as to the state of the land, and as to what parts of it require drainage and what do not, it is absolutely necessary that the forester have a knowledge of the habits of plants generally, as found growing wild in this country. With a knowledge of plants and of their natural habits, any experienced man, in walking over land, may readily point out the portions that require draining.

325. The distance apart at which drains should be put on the ground, depends entirely upon the nature of the soil to be dried; that is, if the soil be a stiff clay, or any other of a retentive character, the drains may require to be laid on as close as twenty-five feet one from another; and if, on the contrary, the soil to be dried be of an open sand or gravel, through which the water can pass freely, fifty feet distant may not be too far separate. In all cases where I drain for the planting of forest-trees, of whatever nature the soil may be, I never now put on drains closer than twenty-five feet, nor wider than fifty, if the soil require draining at all. If the soil for a plantation of trees be drained more frequently than at twenty-five feet, the trees are very apt to be blown up by the roots when they come to be heavy topped, particularly if the drains are not kept in a clean state; and if land requires draining at all for the growing of trees, it is my opinion that fifty feet should be the greatest distance; for beyond that distance between drains, land cannot be said to be drained efficiently. From thirty-five to forty feet apart may be said to be the average distances at which we lay on our drains, and in general cases those distances answer well.

326. The depth and general size of the drains must in a great measure be regulated by the nature of the soil to be dried. In a heavy clay soil I now find that open drains, such as are generally used on woodlands, should be at least thirty-six inches deep; upon a light friable soil, from twenty-four to thirty inches may be quite deep enough; and according as the soil may be inclined to be light or heavy, any intermediate depth between the two extremes above specified may be fixed upon—always observing, that the more the soil is inclined to clay or moss, the deeper the drains should be made. Within the last eight years I have had a very extensive experience in the drainage of land for trees in all parts of the country, and from this I have found it absolutely necessary to depart from the depths of drains formerly considered sufficient to dry ground, as I found that drains made from fourteen to twenty-four inches, as at one time recommended, were not deep enough to dry wet land sufficiently for the healthy growth of trees. I now, therefore, lay down twenty-four inches as the least depth I would

recommend for draining under any circumstances, and thirty-six inches as the greatest. At whatever depth drains may be made in the first instance, it is in all cases an understood point that they should be gradually made deeper afterwards by periodical cleanings; and thus they may be made deeper for the promotion of the health of the trees as they become older and send their roots further into the earth in search of food. This is the reasonable way of going to work—viz., to dry the land sufficiently for the descent of the roots of trees according to their age; and on this principle, if drains on woodlands are made thirty-six inches deep at first, and when the crop is young, they ought to be gradually made deeper from frequent cleanings, so that by the time the crop is, say, fifty years old, the drains may be five feet deep. In all cases of draining on moss land, a sufficient allowance should be made for subsidence, as such soils generally shrink from a fourth to a third of their bulk after drainage, according to the quantity of organic matter in them.

327. The breadth of all such drains, at the surface of the ground, must of course vary according to the depth required. The rule which I have laid down for my own practice as regards this is, to make all open forest drains one-third wider at the top than the depth intended; that is, if the depth of a drain be fixed upon as thirty inches, the breadth of the opening at top will require to be forty inches; and so on with any other depth. The breadth of all forest drains at bottom ought to be sufficient to allow a common spade free room to pass along for the purpose of cleaning.

328. The cost of making such drains as have been above specified must always be regulated by the nature of the soil, and the price of labour in the neighbourhood where the work is to be done. I get drains thirty inches deep, and requiring to be picked in the under-half, done for three-halfpence per yard, lineal measure; and drains thirty-six inches deep, requiring extra picking, for twopence per yard.

329. A particular point to attend to in the draining of moor or waste land, for the planting of young forest-trees, is the manner of laying on the drains upon the ground: they must be laid on in that position which is found to be the best adapted for drawing off and intercepting the superfluous water in its natural descent. I have seen several plantations of late, and those of considerable extent, drained in a very inefficient manner, the drains not having been properly laid down upon the ground. To those who may be unacquainted with the art of making open drains upon moor or waste land, the following hints may be useful: It is a very simple process to drain any piece of land having a moderate natural descent to one side. In such a case nothing is necessary but to make the drains in that direction which is indicated by the fall of the ground; but where the

ground may be what is termed a *dead level*—that is, having no perceptible fall to either side—the case is altogether different, and requires both experience and consideration to drain such a piece of ground properly. Again, where the surface to be drained is a steep slope with many inequalities, much caution and consideration are necessary in order to lay on the drains upon the ground in that position which is most likely to be effective in intercepting the water as it falls from the various high parts into the various hollows; and in order to make all this as plain as possible, I shall illustrate the manner of going to work by reference to a few figures.

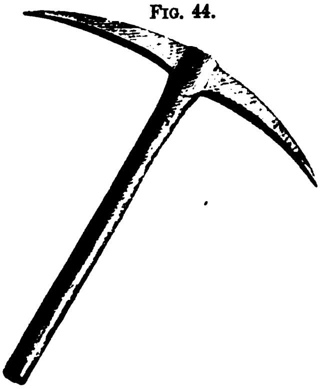


FIG. 44.

330. The operator, in making open drains upon moorland, must be provided with common tools as generally used for that purpose,—namely, the line upon *a reel*, with iron pin attached to the other end, for marking off the drains; a flaughter-spade (see Fig. 17), for the purpose of cutting up the surface or turf; a common pick (see Fig. 44), for loosening the subsoil and taking out stones where they occur; and the common spade, for throwing out the earth and clearing up the bottom of the drains. In operating among the roots of old trees it is also found necessary to have in use the implement called the mattock, or pick-axe, which is merely a sort of pick, having its two ends made in the shape of an axe; the one end with its axe made at right angles with the handle, and the other on a line with it (see Fig. 45). With this implement, with its axes made to cut different ways, the operator can with great convenience cut roots lying in any position in the ground. The most necessary implement for the superintendent of draining operations is the spirit-level (see Fig. 46), which no drainer ought to be without, and which can be bought for 15s. This is an instrument that I use myself in the case of taking levels for drains; and in using it I put the instrument, with appendages, into a hole bored by a gimlet in the top of my

FIG. 45.

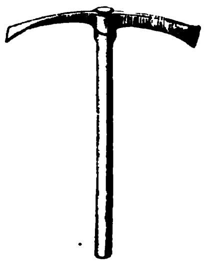
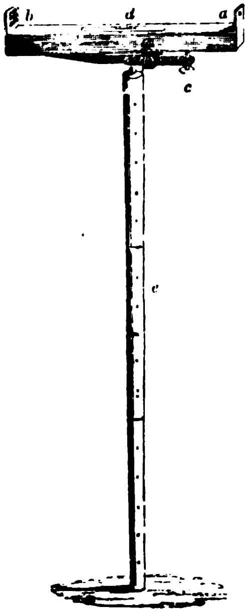


FIG. 46.

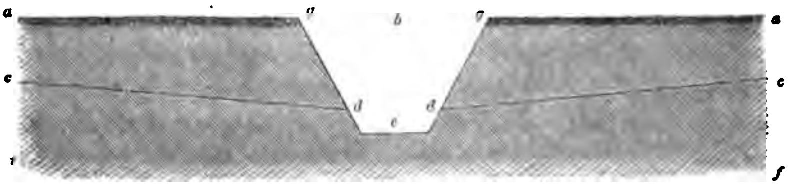


walking-staff, as shown in the Figure. When in use, the spirit-level is placed in a frame of brass, a part of which operates by pressure against the bottom of the instrument, as a spring to adjust it to the level position *d*, by turning the large-headed brass screw *c*.

A perpendicular stud is fixed to the under part of the framing, and placed firmly into the gimlet-hole in the top of the staff *e*, which is pushed into the ground at the spot from whence the level is desired to be taken. There are two eyesights; *a* and *b*; *a* being merely a small hole for the eye to be placed against, and *b* a square opening, with a hair-wire crossing it in the middle.

331. Being furnished with the implements above mentioned, and having a spirit-level of the description referred to, if it is required to drain a flat bog for the purpose of planting trees in it, the drainer will proceed as follows: Look for the lowest part of the ground to be drained, and if this cannot be decidedly ascertained by the eye, set up the spirit-level about the centre of the flat ground, and take sights from it all round in order to find out this point. In using the instrument, it may be unnecessary for me to notice, that the height of the eyesight *a* from the ground must be deducted from the point observed—that is, if the object-pole used be marked in feet and inches, and the hair-wire, in taking a sight, hit the same at six and a half feet—then, if your eyesight be three feet from the ground, the difference of level between the two stations will be exactly three and a half feet; that is to say, there would be three and a half feet of descent from the spirit-level station to that of the station where the object was placed. On the other hand, if, in looking through the eyesight, the hair-wire hit the object-pole at twelve inches from the ground, this twelve inches must be deducted from the height of the eyesight: and supposing that to be three feet, then the ground at the station-pole must be two feet higher than that at the spirit-level. Having ascertained, by the use of the spirit-level, the lowest part of the ground to be drained, and being aware how deep a main drain can be got made there in order to carry off the water from it, cut a main drain along the lowest part of the ground all through, and make it empty itself at the lowest point possible. This main drain must be made of a size correspondent to the quantity of water it is likely to be required to contain, which will depend upon the extent of ground to be drained: in the present case the main drain must be deeper than ordinary, in order to give fall to the smaller ones into it; but, in a moderate case, we may say three feet deep and five feet wide at top. Now let Fig. 47 represent this main drain upon a flat piece of ground: from a little explanation on it I will be able to make myself properly understood in reference to the smaller drains which are to be led into it.

Fig. 47.



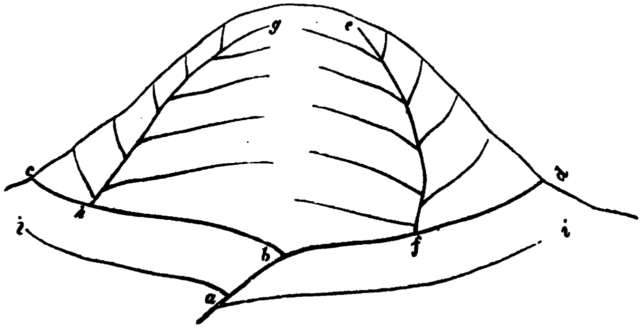
332. Having made the main drain of the form shown in the Figure, lay off your smaller or common drains at proper distances—say thirty feet from each other, and at nearly right angles to the main drain; and in making these, say that you wish to have them thirty inches deep, make them that depth at the top, or the end furthest from the main drain, as at *c c*, and proportionally deeper as you approach it; and when you finish the small drains into the main one, you can have one foot and a half of descent between the two ends of your drains, which is quite enough for a drain of any ordinary length in a plantation, where they are left open, and of course can be scoured in order to keep a clear run. The run of these small drains is represented by the two lines *c d* on each side of the main drain *b* in the Figure. From the surface at *a*, to the bottom of the upper end of the drains at *c*, is thirty inches; and from the surface upon the side of the main drains at *g*, to the bottom of the lower end of the small drains at *d*, is forty-eight inches; giving eighteen inches of a fall upon the small drains from *c* to *d*. It will be observed that the lower ends of the small drains at *d* are kept a few inches above the bottom of the main drain at *e*: this precaution should in all cases be used where there is not much descent for the water. Were the smaller drains made to terminate in the very bottom of the main one, the accumulation of mud from the different small ones would soon be so great as to check the progress of water at the ends, and cause the drain to become stagnated; but by keeping the bottom-level of the main drain a few inches under the bottoms of the small ones, although mud should accumulate in the former to a considerable extent, the others are not affected by it; and if the main one be cleaned once a-year, all is kept right with regard to the small ones.

333. It is a point of practical wisdom in draining not to have too many smaller drains running into a main one, unless, indeed, it be of very great dimensions; but if it should be found necessary to continue all small drains into one main for a great length—which will depend upon the nature of the ground—the latter should be made larger as it increases in length, with the view of containing the increase of water from the small drains upon its sides. When water increases to a great quantity in a main drain made upon soft soil, it is very apt to be injured, and to have its sides

broken down or wrought in upon ; in order to avoid this, it is a better plan not to allow the small drains to run above one hundred and fifty yards without falling into a large one, which, if possible, should be made to have an outlet for itself without the bounds of the plantation, or into a stream, if the ground contain one ; for a natural stream or burn makes at all times the best outlet for water from main drains ; and, if possible, this should always be done.

334. In putting open drains upon land having a steep declivity, they should be run nearly at right angles with the descent of the ground ; but, at the same time, care must be taken to make every drain with a slight fall downwards ; for if they have not at least one foot in a hundred of descent, they will be apt to become choked up with mud and other vegetable matter, which is sure to accumulate if not carried away by a brisk run of the water in the drains. I have already said that where the ground has a slight natural fall—say of about three or four in the hundred—the drains may very properly be made to run in the direction of the same ; but beyond this the fall would be too much, and would certainly prove injurious to drains. Caution therefore is necessary upon this point, in case of overdoing the thing ; for if the drains were to be made with the natural fall of the ground, that being say six in the hundred, the effect of such a rapid descent of the water during a flood would ruin the drains ; and if the soil were of a sandy or gravelly nature, the undermining of their sides could not but take place, and the whole work would prove comparatively a ruin. It should in all cases be observed, where the soil is of a light, sandy, or gravelly nature, to give no more descent to the drains than will carry the water briskly along and prevent stagnation ; and where the soil is stiff, a quicker descent may be given without doing damage so quickly as in light soil. In order to make the method of draining upon steep slopes as easily understood as possible, I shall illustrate the same by reference to Fig. 48, which is a representation of my method of draining a hill-side with open drains for a young planta-

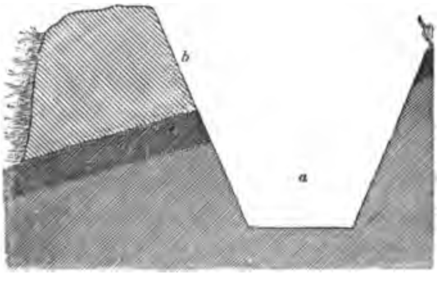
FIG. 48.



tion, and which I consider the best method possible for intercepting water in such situations; and as I find that Mr Stephens, in his *Manual of Practical Draining,* has an illustration of the same kind, I shall here give the same, with his explanation. In speaking of making open sheep-drains upon hill-pasture land—which is equally applicable to plantation-ground in like circumstances—Mr Stephens says: "Open surface-drains in permanent pasture (or plantation-ground) exhibit the form represented in Fig. 48, where the leaders (or sub-main drains) *e f* and *g h* are cut with the greater slope down the hill the steeper the face of the acclivity is, and the feeders (or small drains) are cut across the face, nearly in parallel lines, into their respective leaders. In this way the water is entirely intercepted in its passage down the hill. Where one drain enters another, the line of junction should never be at right angles, but always at an acute angle with the line of the flow of water, as at *b.* And where small drains enter a large, they should not only enter with such an inclination, but where they come from opposite sides, as in the case above, they should enter at alternate points, as shown by the three drains above *f,* and not as represented by the three pairs of drains above these towards *e.*" The large drain *c b d* may either form a part of the lower fence of the plantation, or run along the bottom of the hill-ground; and the main drain, from *b* to *a,* be made to run out in the direction of the outlet; and other small drains, as at *a i,* be made into it upon the level ground, if required.

With regard to the method of making open drains upon hill-land, such as has been described above, I may add from that excellent author, Mr Stephens, upon this head as follows: "There are various ways of making drains upon grass: one is to turn a furrow-slice down the hill with the plough, and trim the furrow afterwards with the spade. When the grass is smooth, and the soil pretty deep, this is an economical mode of making the open drain. Every line of them should be previously marked off with poles when the plough is to be used. But where the grass is rough and strong, and swampy places intervene, the plough is apt to choke and come out of the ground, by the long grass accumulating between the coulter and the beam; and it makes at best very rough work, while the horses are apt to strain themselves in the swampy ground.

FIG. 49.



"A better, though more expensive, mode is to form them altogether with the spade. Let *a,* Fig. 49, be a cut thrown out by the spade, nine inches wide at bottom, sixteen inches of a slope on the high side, and ten on the low, with a width of twenty inches at top along the slope of the ground. A large turf *b* is removed by the spade, and laid with its grassy side down the slope, thus preserving the grass on the lowest side of the cut, the shovellings being thrown on the top of the turf to finish the bank neatly. Such a drain catches all the water descending the space between it and the drain above, and leads it to the sub-main drains, as *e f* or *g h*, Fig. 48, which are of similar construction, but of larger dimensions, running more perpendicularly down the hill, with their lower end joining the large main drains *b c* and *b d*." Such is the method advised by Mr Stephens for the making of sheep-drains upon pasture-lands, and it is equally applicable to the draining of land for a new plantation, only with this difference, that drains for woodlands are generally made much deeper than those for sheep-pasture; and I have quoted the above from Mr Stephens, as it exactly corresponds with my own method of going to work in draining for wood upon steep sloping banks. In conclusion upon draining, I beg to remark, that all main drains should be made in the lowest part of the ground to be dried: they should increase in size as they increase in length, and according to the quantity of water likely to be poured into them; and this not only in the time of general rainy weather, but the time of a flood must be taken into consideration, seeing it is then that the drains are mostly required.

All sub-main drains should be made in a position between the main drains and the smaller ones; and as they are intended to collect the water from the smaller drains and convey it to the main ones, they should be of a convenient size between the two. All open drains in a wood ought to be examined and cleared out once in two years; for if they are not attended to in this respect, they are apt to choke by vegetable matter lodging in them, if the ground be level, or by gravel, if it be steep, and the land of a light character.

SECTION VI.—UTILITY OF ROADS IN FORESTS AND PLANTATIONS.

335. There is nothing that facilitates forest operations so much as judiciously laid out roads; they not only promote a superior mode of all the usual works that are necessary in tree culture, but they invariably add a large per-centage to the value of the produce, as compared with that from plantations in which no well arranged system of roads exists.

336. I think that I speak within bounds when I assert that the produce of any plantation—say of some hundreds of acres in extent, and in which there are no roads well laid out for the convenient removal of wood—is at least twenty per cent less in value than that of a plantation of the same extent, and under equally advantageous circumstances otherwise, but in which there are roads well and conveniently laid off. This is a fact which must appear evident even to the inexperienced in such matters, as the removal of produce from a large plantation, in which there are no proper and convenient roads, is such a drawback upon its value as to prevent many from engaging in it at all, and consequently compelling the proprietor to take for wood lying in such a plantation whatever price may be offered for it, and such a price as he would not accept under other circumstances.

337. I have so frequently seen the very great loss sustained by proprietors from the want of roads in their plantations, that I have to condemn in the strongest terms the extremely narrow policy of planting any enclosure of considerable extent without laying out, and that in a proper and judicious way, roads in it. The necessity of roads in a plantation is not of course felt at first when it is planted, and from this the making of them at such a stage is often put off and altogether neglected on the score of expense; but this is a great mistake in forest management, and invariably proves a source of unsatisfactoriness in the long run.

338. I stated that I have frequently seen the great loss sustained by proprietors from the want of roads in their plantations. I shall give one example of this: Some time ago I was called on to inspect the plantations on an estate on which there is a very considerable extent of them, and some of which are large. On examining one of them, about four hundred acres in extent, the crop of which was oak, with larch nurses on the lower parts of the hill occupied, and larch and pine on the higher, all of some twenty-five years' growth, I found that about one hundred acres of it had been thinned on one of its sides, and that there was only one road right through the middle of it, which had been cleared for the purpose of shooting game, and not intentionally for that of removing the produce of the plantation. While walking with the forester through the portion which had been lately thinned, on observing that no roads existed for the removal of the thinnings, I inquired how he managed to get the trees removed without them. He replied that he was not allowed money for such work, and that his instructions were to sell the thinnings to the best advantage under the circumstances. I next inquired the price that he got for the thinnings, and found that it was 2s. per hundred lineal feet—they having heen sold for coal props, exclusive of the oak. For the locality this was an extremely low price, as I knew that some of my acquaintances were selling the same description of trees, on places equally distant from a port, at 3s. 6d. per hundred lineal feet; but there was this difference in regard to their produce—it was in plantations accessible on all parts by good and well laid off

roads. I advised the forester to sell no more of the thinnings till after I had given my report to the trustees who had the management of it, and until he should have further instructions from them on the subject. From my inspection, I recommended in my report that proper roads should be made without delay in this plantation, and stated that if this were attended to, the advantages would not only be a higher price for the trees that were to be removed at the time, but also for the thinnings at all after stages of the crop. Accordingly, roads were made as I advised; and the result was, that the advance in price of the trees afterwards, compared with that which had been realised before, more than paid for the expense of the roads, thus leaving them a permanent improvement on the property. This is only one case out of very many similar ones I could point out; but it is enough for my purpose, and sufficient to warn any sensible parties who have the management of landed property, to guard against selling trees in any plantation without first giving the purchaser the advantage of roads whereby to remove them. Where this is not attended to, the loss must come on the proprietor of the estate, and not on the purchaser of the trees, as the latter will in all cases take care of himself, and give only such prices as will enable him to meet the market under the circumstances.

339. When I came to take the management of Lord Seafield's woodlands, I found few or no roads in any of his extensive forests, and in consequence of this no timber merchant of any standing would come into the country to make a purchase. My very first work, therefore, was to have roads made so as to completely open up the forests from all points; and since this important work has been accomplished, I have no difficulty in getting purchasers of the most respectable class to come into the country and settle in it, so as to do a large business.

340. The utility and advantages, therefore, of roads in forests and plantations are immense, and should on no account be lost sight of by any proprietor who wishes to make the most of the resources of his estate; as, where this is neglected—and I know it often is so—at least twenty per cent of the value of the produce is lost.

SECTION VII.—LAYING OFF AND MAKING OF ROADS IN NEW PLANTATIONS.

341. I have already hinted that, in all plantations of any considerable extent, it is absolutely necessary to have vacant tracts left through them unplanted, in the form of roads. In laying these off in a new plantation, care should be taken to see that no part of the wood is above one hundred and fifty, or at most two hundred, yards distant from some one of such roads.

The necessity of this precaution will appear evident, when it is taken into consideration that the trees, when grown to any considerable size, will have all to be carried from the interior to such roads, in order to have them taken away in carts; and when the trees become large, and require to be carried a considerable distance, much valuable labour must be wasted before they can be laid down cart-free by the men.

342. The roads in a plantation need not be made more than fifteen feet wide. In all cases, however, they ought to be so broad as to allow two carts to pass one another with freedom when laden with wood.

When the roads are marked off, which of course ought to be done previous to the ground being planted, they ought to be divided from the rest of the ground by a drain twenty-four inches deep, running along each side of them throughout their whole extent, whether the ground may be wet or not. These are meant not only to keep those roads in a dry, firm state, but to give them an appearance distinct from the rest of the plantation; being thus drained on each side, they are not apt to be cut or damaged by a cart or any other wheeled carriage passing along them; and when thus kept dry, they form a fine ornamental green ride for the proprietor and his friends at all times, as well as answer the purposes of accommodation in wood operations. But in order that they may the better answer the ends in view, all sudden heights and hollows should be made easy, by taking from the one and adding to the other, and where any very soft parts may come into the line, these should be made dry by a stone-built conduit passing across and under the road, so as to connect the drains on each side of it. Where they pass along the sides of a sloping hill, they should be levelled by cutting into the slope on the upper half, and by adding the material so removed to the lower. And, of course, all large stones should be removed from them, and the line made smooth.

343. If there be any particularly romantic-looking spot within the bounds of the plantation, the road should be made to take a turn in that direction; or if there be any particular height from which a distinct view of the surrounding country may be had, make a road to pass by it, with a narrow footpath leading up to it. In short, in making roads through a plantation, as well as in making walks through pleasure-grounds, good taste and ornament should be kept in view; and it is as easy to do any piece of work well as otherwise.

344. In plantations where good taste is kept particularly in view, it is very requisite to have holly trees planted along the sides of the roads; as also privets, rhododendrons, Portugal laurels, and bays, all of which thrive well although a little shaded by trees; and in the winter season particularly, they give a fine effect when contrasted with the leafless hardwood

trees. Indeed, those ornamental points in forest scenery are by far too little attended to. Our woods might be made even more interesting than the best-kept gardens, in the winter season, were this kept in view; for what is prettier than a holly, with its clustering red berries, in the winter months, when the birds delight to congregate and feed upon them? And even in the month of June, what is more beautiful than the rhododendron, with its dark purple flowers? Such objects, when found in a forest footpath, give rise to reflections unknown upon beholding the same plants in a flower-garden.

SECTION VIII.—MAKING OF CLOSE OR SHUT DRAINS IN LAND OCCUPIED BY FOREST-TREES.

345. Are there no means whereby drains in forest land can be kept shut, and yet be secure from the roots of the trees? is a question which has very frequently been put to me; and on this account I have devoted this as a separate section, in order to answer this important question as far as my experience relative to this point will permit me to speak.

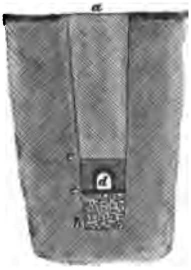
346. It often occurs about the home-grounds of landed proprietors' seats that open drains are an eyesore, although they may be actually necessary for the welfare of the trees which may be growing upon the ground in such situations; and it is in cases of this nature that proprietors are anxious to be made aware of the best method for preserving shut drains in such situations.

347. It is a well-ascertained fact that the roots of all trees incline more to spread about the sides of drains than any other part of the soil they may grow in, whether those may be shut or open drains; and of this I have had ample proof in the case of covered drains in fields along the margin of woods. As an example in point, I may state that at Craigston, in Aberdeenshire, a low-lying meadow of pasture-land, which had been drained effectually, was observed to become gradually covered with rushes and several other plants which are found luxuriating upon damp soil: the cause of this was undiscovered for several years, until at last some particular parts of the meadow were covered with stagnated water the greater part of the winter months. The inefficiency of the drains was at once suspected as the cause of the water lying upon the surface; and as this was about the time that I went to be forester upon the place, Mr Urquhart, the proprietor, requested me to make an examination of the state of the drains in the meadow. On ascertaining from an old man, who had assisted in the making of the drains, the particular direction of the main or

leading ones, I found that the principal drain ran along one side of the meadow, and the greater part of the smaller ones fell into it from the other side. This principal drain, into which the greater part of the small ones emptied, ran along the edge of a wood, there being merely a cart-road, of about eighteen feet width, between the main-drain along the side of the meadow and the edge of the wood, where several ash trees were growing. On being made aware of the position of this drain, my mind was at once made up as to the cause of the dampness in the meadow. I concluded that the roots of the ash trees had penetrated into the drain and choked it up. After reporting this to Mr Urquhart, I had men immediately set to work to open up the drain, beginning at the lower end. We had not got far on with the opening of the drain, which was about five feet deep, until we found its conduit, which was made of stones, blocked up with the roots of the ash trees; and so completely was it choked, that not a drop of water could pass along, the roots having the appearance of large balls of horse-hair rolled up confusedly into bundles. As soon as the main-drain was cleared as far as the roots of the ash-trees were, the drains were quite clear, and the water ran out from the field in every direction. And the main-drain being afterwards left open, the field soon became dry enough, although the smaller drains had been considerably injured from the effect of the water having been pressed back upon them. Now, in this instance, we have an example of the roots of trees proving injurious to drains at no less than five feet deep; and not only this—I have had occasion to observe the roots, both of ash and elm trees, coming through into a garden under the foundation of a wall in search of moisture, which they found in a drain about twelve yards from the wall in the garden. At Gogar House, near Edinburgh, I was witness to a case even more extraordinary than this. In the garden there, there was a well about fifteen feet deep, for supplying the garden with water, which was situated about thirty-five yards from the wall, and within the garden. On the outside of the garden wall there were several large elm-trees growing about the distance of ten yards from it: yet I observed roots of these trees lying upon the water in the well within the garden at eight feet from the surface; and we have thus an example of the roots of trees travelling nearly fifty yards in search of water, and which they got at the depth of eight feet from the surface. These two examples are, I think, sufficient to show that, in order to keep the roots of trees from injuring close drains, their depth will not avail; and this I observe, because I have heard several well-informed gentlemen state that they thought if drains were placed sufficiently deep, the roots of trees will not prove injurious to them. But of the error of such an opinion I am perfectly assured, and could give more examples in order to prove it. Happening to meet with a very intelligent forester some time ago, and wishing to have from him, if possible, some information relative to the point in question, he mentioned that if drains were filled to the surface with stones, so as to cause a dry vacuum to exist in the ground, the roots of trees in the neighbourhood would not enter them. This I can by no means believe nor agree to; for it is well known that moisture will trickle along the side of a drain filled with stones; consequently the roots of trees in the neighbourhood of such drains will very readily seek in that direction, and will follow the moisture to the very bottom of the drain, however deep it may be made, seeing that air must be present among the stones and in the drain also. I accordingly at once condemn this plan as being without effect, and assume that some other method must be adopted. I am not aware, even as yet, of any description of drain which will act properly as such, and into which water will find its way, that will not be affected by roots of trees in its neighbourhood. I am well aware that where water, followed by air, will penetrate into the soil, the roots of the greater part of our hardwood trees will follow in search of food; and as the soil in the immediate vicinity of drains is in a more healthy and attractive state than any other part of the soil to which the roots may have access, they will, without doubt, congregate much in those parts: this is the cause of drains being injured by the roots of trees. Seeing that the roots of hardwood trees incline much to draw nourishment from drains, whether these may be open or covered, and being of opinion that keeping them from having access to such is injurious to their health, it is, in my opinion, bad management, in the growing of trees, to keep the roots from having that nourishment which nature has provided for them in the soil; therefore a plan must be adopted which will not hinder the roots of trees from having access to the drains, but, on the contrary, one by which the process may be encouraged, seeing that trees in such a condition are more healthy than in any other state.

The following is a plan which I beg to recommend to those who may have occasion to require shut drains among trees, which secures the safety of the drain, and allows the roots to have access to the water in it at the same time. It is the only rational method of proceeding, and will be understood by reference to Fig. 50. The depth of this drain, from *a* to *b*, may be forty-eight inches, nine inches wide at bottom, and twelve at top. In filling it, I would first put in about eight inches of rough gravel or small stones into the bottom, as from *b* to *c*, above which I would lay a sole of slates, as at *c*, for the drain-tiles *d* to rest upon. Between each sole I would leave a

FIG. 50.



vacancy of an inch, in order to allow the water to rise up into the tiles from the gravel. The tiles being laid, I would surround them with a puddle of good clay, three inches thick on each side, and the same on the top *e*.

This plan of making drains in ground occupied by trees, with the view of securing them from being easily injured by their roots, occurred to me on seeing an old drain opened in the garden at Craigton, near Glasgow. The garden there was a very old one; and on making some new drains in it, I came upon one of the description mentioned along the edge of one of the walks. When the walk had been made, some gravel had, no doubt, been flung into the drain to answer some purpose, and above the gravel a sole of flags had been put with an angular conduit of stones upon them. When I opened this drain in order to set the water from my new ones into it, I found the roots of the pear-trees, which were at least eighty years old, in excellent health, and in fibrous masses among the gravel under the stones; while among the stones above the gravel there were scarcely any roots whatever, but the drain was in good state.

Now, from what I have observed in the case of several old drains which I have had occasion to lift in gardens among apple and pear trees, the roots of which, it is well known, go down very deep, and travel a great length in search of food, I am perfectly persuaded that any drain made in the way I have pointed out will answer the purpose in question; and my reasons for being confident of this are, that the roots of all trees in the vicinity of drains, when they come in contact with them, travel along the sides of the drains, following the descent of the water to the bottom. Now, when there is much gravel put into the bottom of a drain, the water will gather there from each side of the drain, and filter along through it, consequently the roots of the trees will lodge there also; and as this gravel would not in all cases be able to contain the quantity of water that might lodge in the drain, a provision is made for any extraordinary flow, by having the tile placed above upon soles set a little apart, in order to allow the water the more readily to ascend into the tile, and find egress thus when it might attain this height. In general, however, the water would lodge at the bottom of the gravel, and seldom rise to the top; consequently the roots of the trees would not incline to rise upwards into the tiles, seeing there was no food for them there, nor any moisture to attract them. By placing a band of clay over the tile, the roots of trees are prevented from going downwards into the tiles; and before they can enter the drain, they must run to the bottom, where they are retained among the moisture. Supposing that the gravel were to become so full of the roots of the trees that the water could not pass through it, it could have a passage in the tiles which have been provided for this purpose ; and as the water would still lie to a considerable extent among the gravel, the roots would be detained there, and would not increase upwards for a great length of time. In short, I am persuaded that such a drain, if well done, would keep good for a period of not less than fifty years, which is longer than many do with no roots of trees near them.

CHAPTER IV.

SECTION I.—TREES CONSIDERED AS A PROFITABLE CROP, AND AS ORNAMENTAL OBJECTS ON LANDED PROPERTY.

348. That trees are a highly profitable crop on landed property has already been shown in a former section: I need not, therefore, recapitulate what has been stated on this subject. Still, under this head, I should wish to state a few facts as introductory to the sections which are to follow, and which relate to the character and habits of the trees we cultivate.

349. In all civilised countries the cultivation of trees forms a most important part of their economy, both from their timber and from the food they produce. From the timber of trees our houses are constructed; our implements are manufactured from it, as well as our ships, furniture, and machinery. Besides these uses, in all countries trees are found to be improvers of the climate, inasmuch as they produce shelter from winds in a high-lying, cold, and exposed position, and shade from the burning heat of the sun in those of a hot climate. Not to speak of the fruits we have in this country from the produce of trees, as to us they are more a luxury than a necessary article of food, we may only refer to the fruit of the palms and of many other trees of hot climates, which are really as necessary to the inhabitants as the cereal crops are to us. Trees, then, form a necessary and a profitable crop in all countries at all advanced in civilisation, either in the form of timber, or in respect to the fruits they produce.

350. But trees are not only profitable as a crop; they are also ornamental in the highest degree; for what objects in nature are so grand and so effective as old trees, with their massive stems and spreading limbs, covered with foliage of different shapes and shades? for hill sides would be comparatively uninviting but for the plantations of trees of various shades we plant upon them; and what would be the effect of the waterfall or the river without trees in their neighbourhood? A country without trees is as repulsive to the eye of taste as a picture of landscape would be without

one shown upon it. In short, I would ask, what adds beauty and natural effect to a fine mansion-house? What constitutes the charm and pleasure of country scenery in general? What gives rise to the ecstasy felt on viewing a cascade, or a lake with its islands? What is it that renders the home-parks of our landed proprietors so cheerful, so enlivening, so rich in beauty, and so much praised by the most cultivated minds? I confess that I am enthusiastic in the matter of trees, and that I not only admire them on account of their usefulness and beauty, but I have a feeling approaching to respect for them, more especially when I look upon gigantic specimens of them that have stood over four and five hundreds of years, and have witnessed many generations of feeble men pass away.

SECTION II.—THE OAK—ITS DESCRIPTIVE CHARACTER, HABITS, AND PECULIARITIES.

351. The oak (*Quercus*) belongs to the natural order *Corylaceæ*, and, according to the Linnæan system, to *Monœcia Polyandria*. The descriptive character of the genus is, according to Don: Flowers unisexual. Males disposed in long, slender, pendulous catkins, in groups. Each flower consists of eight or more stamens, and these are attended by 6—8 bracteas (or floral leaves), that are coherent at the base, and resemble a 6—8 parted calyx. Female flowers erect on axillary peduncles, a few upon a peduncle. Each flower consists of a pistil, whose ovary, and the basal part of whose style, are invested with an adnate calyx, toothed at the tip. Style short. Stigma three-lobed. Fruit an acorn; its lower part having an imbricate cup.

352. There are upwards of sixty distinct species of the oak, chiefly natives of Europe and America. We shall only, however, refer to four of them—viz. to the two British oaks, *Quercus pedunculata* and *Q. sessiliflora*—as they are preferable to all the other sorts for the quality of their timber; to the *Q. Cerris*, or Turkey oak, and to the *Q. Ilex*, or Evergreen oak, as they are both hardy and worthy of cultivation for ornamental purposes in this country.

353. With regard to the two British species referred to, they are generally allowed to be the most durable of all our forest trees. Many have maintained that they are the most profitable trees that can be planted upon a bare soil and site; but as to this, I am now convinced to the contrary. I at once admit that where the oak is allowed to arrive at full maturity, and cut down neither too young nor too old—say at from eighty to one hundred and twenty years—it is the most valuable wood we have as to dura-

bility; but in regard of profitable return to the grower, it is far surpassed by the larch. Having cut down both oak and larch at all stages of their growth, I have invariably found that, under good management, and giving both trees a proportionate number of years on a given soil, the larch is by far the most profitable. There is an old saying among foresters—and it is a true one—that a larch will buy a horse before an oak will buy a saddle. But notwithstanding that, as regards profit, the oak must yield to the larch, it is and will be an indispensable tree in British forests, and will likely remain so as long as the British navy has to be maintained, and as long as our landed proprietors retain a taste for the ornamenting of their grounds upon anything like a scale of grandeur and natural effect.

As to the oak being a tree well adapted for the park, it would be superfluous to attempt setting forth its merits in this respect. This has already been done by many able writers upon the subject; and I admit that the tree is indeed, in an ornamental point of view, worthy of all the praise that has been bestowed upon it; and as to grandeur and effect, it may indeed be styled "the king of the forest."

354. I stated that there are two distinct species of British oak, namely, the *Quercus pedunculata*, and the *Q. sessiliflora*. The botanical characters of each of the species are these: The *Q. pedunculata* has its leaves oblong, smooth, *dilated upwards*, with very short petiols or foot-stalks; the lobes *obtuse*, with rather acute *sinuses;* the stalks of the fruit *elongated*, and acorn *oblong*. Fig. 51 represents the leaf of this species, and Fig. 52 the fruit upon its elongated stalks.

FIG. 51.

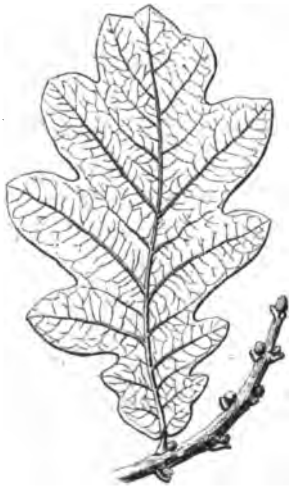
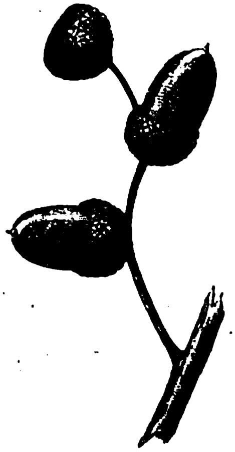


FIG. 52.



The *Quercus sessiliflora* has its leaves on *elongated* foot-stalks, smooth and oblong; the *sinuses opposite,* and rather acute; the lobes obtuse; the fruit sessile or *sitting,* and *oblong.* See Figs. 53 and 54.

FIG. 53.

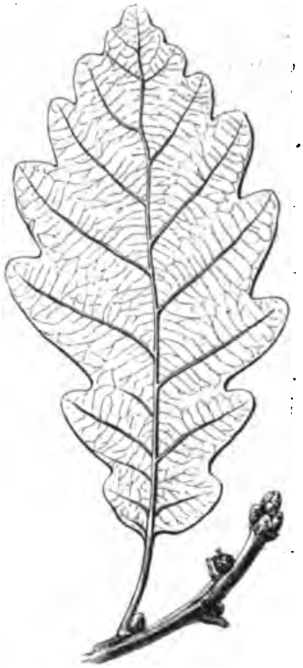
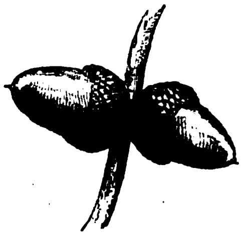


FIG. 54.



The above are the distinguishing characters of the two species, as given by botanists; but such descriptions are not at all sufficiently distinct for the distinguishing of the two species, when laid before a person who may be unacquainted with botanical terms; and for the guidance of such, I shall give the distinguishing marks of the two species, as observed by some of our most intelligent practical foresters who have for many years paid attention to the habits of each, and who, with myself, are decidedly of opinion that the one sort is unquestionably superior to the other.

It will be observed that the two most distinguishing characters of each of the two species of oak, as mentioned above, are—*Q. pedunculata* has very short petiols (see Fig. 51), and the fruit has pretty long foot-stalks (see Fig.52); again, *Q. sessiliflora* has its petiols pretty long (see Fig. 53), and the fruit is entirely without stalks (see Fig. 54). These, let it be understood, are the most prominent distinguishing characters of the two species, as generally given by botanists, but they are not always to be relied upon; for even in examining a number of leaves upon the same tree, we may find some of them that will answer to both species. But, generally speaking, these differences between the two kinds do hold good to a great extent; and an experienced person, who has been long in the habit of examining the leaves of each species, can at once, even from the forms as already explained, point out the different sorts. But besides this, there is another mark of distinction, which is even more decided than the marks taken from the fruit and leaves—namely, that from the buds upon the young wood. The buds upon the *Q. sessiliflora* are more prominently brought out upon the wood than those of the *pedunculata;* and the wood at the base of the buds is also more fully developed. See Fig. 53, where a piece of the young wood is shown; and compare the buds as shown there with those shown upon the young shoot in Fig. 51, which represents a piece of the young wood of the *pedunculata.* As in Fig. 51, the young wood swells but slightly at the base of the buds, and this is generally the case with the *pedunculata;* whereas in Fig. 53 the young wood swells boldly at the same point; and this is generally the case with the *sessiliflora.*

355. There are, indeed, many who deny that there are two species of the oak found in our forests; "for," say they, "the distinguishing characters of each do not always hold good." This I readily admit; for so far as the distinguishing characters that have been pointed out go, they are very often blended together in one tree. But this is easily accounted for by the two species having been long growing in the country together, from which have arisen many trees, which are no doubt what may properly be termed hybrids between the two. When, however, we do find the trees distinctly developing each its own characters, the marks given will hold good, and point out which are the true original sorts, and which are hybrids. And further, upon this point, the *Q. pedunculata* is, to appearance, not such a free or rapid growing tree as the *sessiliflora.* At all the stages of the growth of both trees, the *pedunculata* has always a more stunted, and, as it were, a more unhealthy, appearance than the *sessiliflora;* in fact there is, to the experienced eye, an expression in each tree which at once distinguishes the one from the other, and which at the same time cannot be explained, although quite evident to the mind and eye of a practical man. I could myself, at first sight of an oak tree, say which of the kinds it was; and yet I could not explain to a person with me the marks of distinction which led me to say that this tree was one sort and not the other.

356. With regard to the quality of the wood of each of these kinds, I am aware that many say that the wood of the one is as good as that of the other, and that any distinction in this respect is occasioned by the difference of the soil and climate the trees may be found growing in. Some have even gone the length of asserting that the sort which is generally esteemed as the best in the quality of its wood, is in reality the most worthless; but this has been said by men who had no knowledge of the truth of the matter, and has been at all times contradicted by those who have had ample experience in the cutting up and using the trees of both sorts. For my own part, I am so thoroughly convinced of the superiority of the wood of the *Q. pedunculata,* that in planting I reject every young plant that has the appearance of the other sort; and this in order that I may decidedly introduce the *pedunculata,* and exterminate, if possible, the *sessiliflora,* the wood of which is decidedly of an inferior quality as com-

pared with the other. As to the truth of what I have asserted, I shall state one example, among many others which I could give, of the comparative worthlessness of the *sessiliflora* oak. When at Arniston, I cut down several of that species, of full age, and of pretty large dimensions. In the year 1843 I had occasion to cut up a considerable quantity of oak for colliery waggons, for which purpose I sent to the saw-mill, among several of the *pedunculata* sort, three trees of the *sessiliflora*, which were all cut in the month of June for the sake of their bark. In the act of cutting up the wood, the men remarked that there was a great difference in the quality of the wood in some of the trees as compared with that of others; and that those which had the greatest portion of *red* or *heart-wood*, were the trees which were easiest to saw. This was exactly what I wanted to ascertain. I wanted to see if the men, who were not even aware that there were two sorts of the British oak, they being merely sawyers and not foresters, in their own simple way could detect the difference between the two species in the act of cutting them up; and they did so very readily. I stood in the mill and saw them cutting up one of the *sessiliflora*, and found that the saws went through it much in the same manner that they would do when cutting up a piece of elm. But when they put on a tree of the *pedunculata* sort, the saws became heated in a very short time; and before they could go from end to end of the tree, the men had to pull back the tree for a time, and allow the saws to cool. This at once shows the hard and solid nature of the one tree as compared with the other. In the above example, the trees in question were distinct specimens of the two sorts, being very true to the general marks previously given; and as they were all taken from the same wood, and were of the same age, they could not be differently affected by soil.

357. It is, in my opinion, a point well worthy the consideration of all interested in the welfare of our home woods, to see that the *pedunculata* sort be introduced in a decided manner, and the *sessiliflora* rejected. It is, indeed, fortunate that the latter is by no means plentiful as compared with the other; but as it will no doubt have a tendency to increase if not watched, it will be wisdom in those who have the management of woods to see that it is kept as much down as possible.

358. It is well known that the wood of the oak is used for a great variety of purposes, even to name which would be superfluous; but the principal purpose for which the largest of our oak trees are used is ship-building. From the Government forests in England a considerable quantity of oak is cut for the supply of the navy; but not the tenth part required is produced from that quarter. A large quantity is supplied from the different proprietors in the kingdom, who, of course, rear it upon their

estates for sale; and, in addition to this, a large quantity is generally got from abroad; thus showing the great necessity there is for an increase in the extent of our home forests, in order that we may not be so much dependent upon other nations for a supply of timber to keep good our navy.

359. The quality of oak timber, like that of all other trees, depends very much upon the nature of the soil and situation upon which it is grown. I have had oak timber cut up from situations near the sea, and also far inland, and upon a high exposed part; and my experience upon this point leads me to say, that the trees grown in a low situation and upon a light soil do not produce such hard and durable timber as trees grown upon the same nature of soil on a high situation; but trees grown in a low situation, and upon a heavy clay soil, produce better timber than trees grown upon the same nature of soil on a high situation. This it is reasonable to suppose; for, upon a high exposed part, trees will not succeed well upon land of a cold bottom.

360. From experience, and from extensive observation of the quality of the oak as produced from different soils and situations, I am convinced that in all sheltered situations the oak produces the best timber upon a heavy clay soil, or heavy loam; and upon exposed situations, the best oak timber is produced from land of a loamy, or rather light dry nature.

In Scotland, as well as in England, the best oak timber I have witnessed is produced on a loam, resting partly upon sandy clay, and partly upon gravel beds. I may mention one particular tree, of the *pedunculata* sort, upon the Arniston grounds, which is still growing, and in good health, upon a loamy soil, situated on a sloping bank. It is between seventy and eighty feet high—is eighteen feet in circumference near the ground—and contains about two hundred and fifty cubic feet of timber. The size of oak timber most suitable for country purposes, is from six to twelve inches on the side of the square; and for shipbuilding, all sizes above twelve inches on the side of the square are used. A great part of the timber used for shipbuilding must be crooked; consequently, oak of a crooked or bent character sells at a much higher rate for that purpose than straight timber, although the one may be of as good quality and of as large a scantling as the other.

361. The oak forms an excellent hedgerow timber tree. Perhaps it is the best for that purpose of all the forest trees we have: for my remarks upon this, see Section headed *Hedgerow Timber*.

362. As a coppice-wood, the oak has long held a high place, more particularly on account of the bark it produces for tanning purposes; but now, since that article has fallen so very low in price, it is not such a profitable

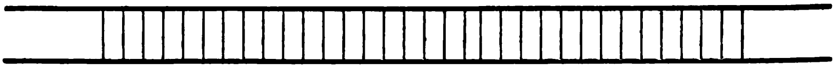
part of forest culture as it has been. For a more particular account of this, see Section headed *Management of Oak Coppice.*

363. The oak seems to have grown somewhat extensively, and even luxuriantly, in the north of Scotland, many hundreds of years ago, and when the great Caledonian pine forests were more extensive than they are now, as in Strathspey we have had oak trees dug out of the mosses measuring from thirty inches to thirty-six inches diameter of stem, and of lengths from forty to fifty feet. These are found on the flat parts of the country, and generally where there is clay under the moss on which they had grown. No doubt they had grown on the better parts of the land, and where they had been surrounded by dense forests of pine, as is still indicated by the character of the land.

364. The oak is raised from seeds, which are named acorns. These generally ripen in the month of November; and as soon as they are ripe, they should be gathered and sown immediately, because they are very apt to be injured by being long kept, more particularly if they be not kept dry and in a cool place. If kept perfectly dry and cool in an airy loft, the acorns may indeed be preserved all winter, and sown in the spring; but as they are extremely apt to be injured by careless keeping, the better plan is to sow them at once when gathered.

365. Some nurserymen are in the habit of sowing them in rows, and others in beds, covered with about two and a half inches of earth. My own plan is, as soon as I have the acorns at hand, to sow them in rows upon the surface of the ground, which I have previously dug and prepared, and cover them with from two to three inches of earth. In sowing them, I mark off the rows about eighteen inches distant one from another. The breadth of the seed in the row may be about five inches, and the seed may average one to every three square inches. In covering the seed, I gather up the earth from the ground upon each side of the row that is sown, until it is the desired depth upon the acorns, taking care not to come too near the seed upon the sides of the row, but keeping it there rather heavier of earth than above; for it is generally upon the sides of the rows that vermin make their attacks upon the seed.

After the acorns have been sown, they must be paid attention to, to see that vermin of any description do not attack them. In the winter season, if mice or rats are in the neighbourhood, they will be certain to attack them; and if they do, traps must be used in order to destroy them. And in the spring months, if pheasants or any other birds commence upon the acorns, nets may be used in order to cover the beds or rows from them; or if these be not upon the place, and cannot be had conveniently, they may be covered pretty closely with the branches of trees, which will keep back birds, and at the same time allow a free circulation of air to the surface of the earth. This I have frequently had to do myself, and found them to answer the purpose very well. As soon as the young plants appear above ground, which will generally be about the end of May, the branches may be removed in order to give the young plants all justice. But about gentlemen's woods, where a home nursery has been established, pheasants are very often numerous; and I have seen them prolong their attacks upon acorns long after the plants were coming above ground. In fact, I have seen the pheasants, in the nursery at Arniston, prove as destructive to the acorns in the month of June as at any other time in the year, and that too after the plants were generally above ground. The plan which I found most effectual against them in such a case, was to have two boards, of about one inch thick by six inches deep, connected by spars of about one inch square and a foot long. These spars I had nailed across upon the edges of the two boards, two inches separate from each other, thus:—



and these frames or sparred boxes I had made in lengths corresponding to the lengths of the rows upon the ground, and had as many of them made as covered all the seed sown, keeping the open side, of course, resting upon the ground, and the sparred side uppermost. This kept the vermin off, and at the same time admitted free air about the plants; and as such frames will last for many years for the same purpose, they ought to be stored by in a dry shed when not in use.

My experience in the cultivation of the oak now leads me to state that the plants should only stand one year in the seed rows; when left longer, they become drawn up and comparatively weakly. I now therefore invariably adopt the plan of planting them out into rows when one year old; and when the plants thus treated have stood three years in the lines, they are much superior to others left two years in the seedling state, and that have stood two years in the nursery rows, both being of the same age. They should next be transplanted into the open nursery ground, into rows about two feet separate, keeping the plants in the rows about four or five inches from one another; and in this state they may remain for a length of time, according to the size that the plants may be required; that is, if the plants are not wished to be large, two years in the rows may be enough, but in no case less; and if the plants are required to be large, three and even four years in the rows may be no more than sufficient.

The oak, the first year after being transplanted, makes very little progress, merely establishing its roots in the ground. The second year it sends out new shoots, and the third grows vigorously. Where it is intended to have plants of a pretty large size for any particular purpose, they ought to be transplanted rather widely in the nursery rows—say at from six to nine inches; and if, at that distance in the rows, they be allowed to remain for four years, they will be very good plants indeed. It is a good plan, in all cases of cultivating the oak, to prune the plants in the spring before lifting them; that is, if it be intended to lift plants from the nursery rows in the month of November, they should be pruned in April, which is a great means of preserving the health of the plants, and keeping them in proper shape.

FIG. 55.

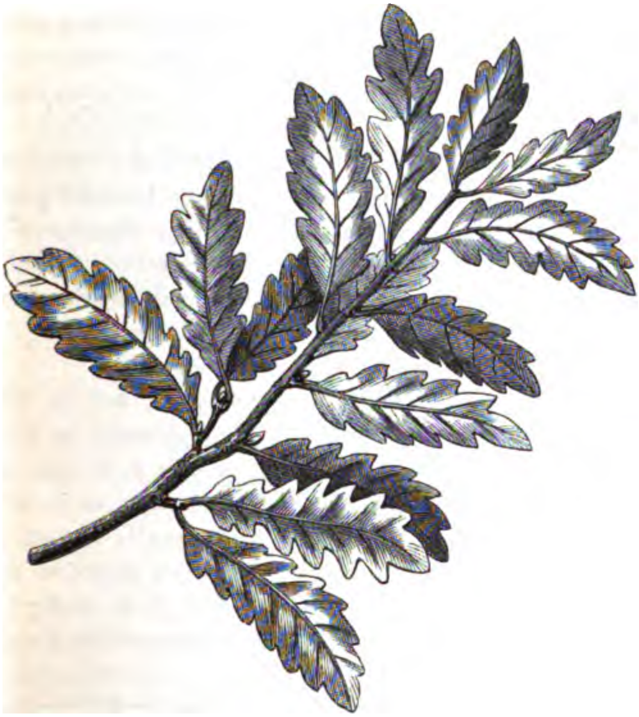


FIG. 57.

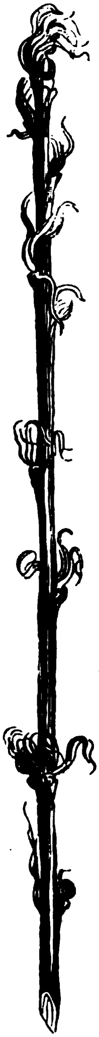
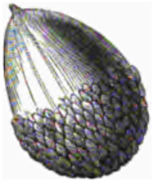


FIG. 56.



366. *Quercus cerris,* mossy-cupped, or Turkey oak.—The specific character of this tree, according to Smith, is: Leaves on very short stalks, oblong, deeply and unequally pinnatifid; hairy beneath; lobes lanceolate, acute, somewhat angular. Stipules longer than the footstalks. Calyx of the fruit hemispherical, bristly. In order to make this description more clear, we give Figures 55, 56, and 57, which represent the form of the leaf; that of the seed with its bristly calyx; and that of the stipules on the young wood.

367. This oak is, as well as the common British ones, a deciduous tree, growing to nearly the same height—viz. from fifty to one hundred feet, according to soil and situation. It is, however, a more rapid growing tree than either of the sorts described, but is comparatively worthless as a timber tree, being very brittle in the texture of its wood. It is a native of Italy, Spain, Austria, and the Levant, and is found to grow well in, and to stand the climate of, Britain. It forms a beautifully-spreading and partly drooping branched tree standing singly on a park, and is indeed very ornamental among other trees of a more upright habit of growth; but it does not resist storm or high winds well, as in such circumstances it is very apt to have its limbs injured and broken.

368. We cannot, however, say much as to the quality of the timber of this tree as grown in this country, as it is only about one hundred years since it was introduced, and as from this we have no proper experience of the timber of it when matured. In short, there are as yet few or no really matured specimens in the country, so that we have no sound experience in regard to its timber qualities; but this seems certain, that, comparing it with the British oak of the same age, its timber is very inferior.

369. The tree ripens its seeds, on the average of years, well in this country, and especially in England, where a supply can generally be had. Plants raised from the seed are very subject to sport—that is, to run off into varieties somewhat different, either in leaf, in seed calyx, or in the general habit of the whole tree; and when a certain variety is wanted to be extended it is generally increased by grafting, either on stocks of the same species, or on the common British oak. In fact, it is chiefly by grafting that this tree is propagated, as by this mode nurserymen find they can produce the exact variety wanted.

370. The *Quercus ilex*, or evergreen oak, is thus described by Willdenow: Leaves ovate-oblong, acute, coriaceous, entire or serrated; hoary beneath. Bark even. Nut ovate. Figures 58, 59, and 60 will more clearly describe this to the inexperienced in botanical terms. (The artist, by mistake, has drawn Fig. 60 too large—it was intended to correspond in size with Fig. 59.) The tree is a native of the south of France, Spain, and Italy; but it grows well and attains large size in the south of England or in Ireland, and even in Scotland it attains, in favourable situations, no mean dimensions; but generally speaking, at best, it is only a very large bush, seldom or never attaining what may be called timber size. But it has one advantage in point of ornament, it becomes clothed from the ground to the top with a dense mass of branches and leaves, which gives it a peculiarly striking effect. This is when it stands alone and unencumbered; for I have seen it form a clean stem of some dimensions when confined among other trees. I know of no

tree so impatient of wet in the subsoil. It is said to be a long-lived tree, and to continue growing for some hundreds of years. It stands well against the sea-breeze, and even seems to luxuriate in it. This is proved from the fact of there being considerable quantities of the tree grown on many parts of the sea-coast on the west of England. It is propagated from the acorns, which are generally procured from the Continent. I know of no tree more difficult to transplant with success, as its roots are generally of the carrot sort, with few fibres. It thrives best in a light, dry, and deep soil.

FIG. 58.

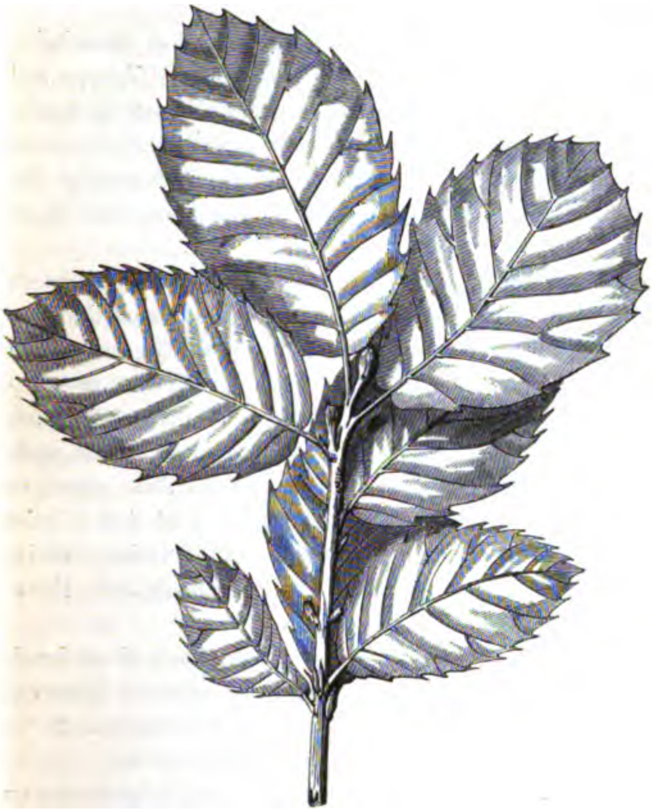


FIG. 59.

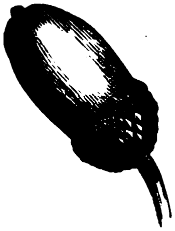
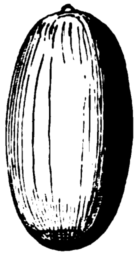


FIG. 60.



SECTION III.—THE ASH: ITS HABIT AND PECULIARITIES.

371. The Ash (*Fraxinus*) belongs to the natural order OLEACEÆ; and according to the Linn. system, to *Polygamia Diœcia.* According to Don, the character of the genus is: Flowers polygamous. Calyx none, or four-parted, or four-toothed. Corolla none. Stamens two in the male flowers.

Anthers sessile, or on short filaments, dehiscing outwardly. Female flowers the same, except that they have no stamens, but have each a pistil that has a bifid stigma. Fruit, or samara, two-celled, compressed, winged at top. Cells one-seeded.

372. There are many distinct species of the ash, several of them being natives of North America, and others of the continents of Europe and Asia; but all of them, in our country, attain, under the most favourable circumstances, only trifling dimensions as compared with the *Fraxinus Excelsior*, or common ash, which is a native of Britain, and perhaps the most useful of our hardwood timber trees for general purposes, if we except the oak.

373. According to Don, the specific character of this tree is: Leaflets almost sessile, lanceolate-oblong, accuminate, serrated, cuneated at the base. Flowers naked. Samara obliquely emarginate at the apex. The leaves have generally five pairs of leaflets, but sometimes six. The flowers are produced in loose spikes from the sides of the branches. On some there are only female flowers; on others, hermaphrodite ones; and on others, male ones; while on some trees the flowers are found in two of these states, or in all of them. This tree, like the Turkey oak, sports a good deal in its habit of growth, and hence there are what may be called varieties of it; but they are mere varieties, apparently affected by soil and situation, therefore I need only refer to the fact.

374. In duration, the common ash tree is superior to many of our hardwood trees, there being instances of them nearly three hundred years old in Scotland; and upon many estates there are ash trees known to be above two hundred years old, and yet apparently in good health.

375. Many object to the ash being introduced into modern landscape on account of the lateness of the tree in coming into leaf, that being generally about the first week of June, by which time most other trees are in almost full leaf, itself standing alone bare, and apparently in the midst of winter. This objection is, in my opinion, very superficial, and unworthy of being of any weight; for this very peculiarity of the tree gives it an interest in the eye of refined taste, which is not to be found in any other tree; for what is more pleasing than to see, at a time when all other trees are in full leaf, the ash first swelling its large black buds, and unfurling its leaves to the summer's sun? Another objection formed against the introduction of the ash into the park is, that it is the first tree to lose its leaves in the autumn. This is indeed true, for the first frost of winter causes its leaves to undo their hold and to fall to the earth; but in this also there is more pleasure than disappointment; for while most other trees upon the lawn have had their

leaves deadened and hardened by the approach of winter, the ash retains the verdure of its foliage to the last, and throws it off at once, rather than submit to have it dangling of a sickly hue. And even when the tree is newly stripped of its leaves, its appearance here and there as a leafless naked tree, contrasts well with the masses of sickly foliage upon the adjoining trees; therefore I must say that I admire the ash as a lawn tree for the very reasons that others object to it. Apart, however, from the lateness of the tree in coming into leaf, and its being suddenly stripped of its foliage in the autumn, the ash is to be admired as a stately proportionable tree, and is well worthy of a place, to a certain extent, in every British landscape.

376. The natural habit of the ash is that of a tall tree of first-rate magnitude, but inclined to grow tall rather than to great girth of stem. In plantations of a very moderate thickness, this tree is extremely apt to run up to a great height without taking a proportionable girth along with its height; but when the plantation in which it grows is kept rather thin and airy, the side branches are easily checked, and excellent tall timber is formed. When growing in a park or open lawn, the ash forms a large-headed tree of imposing effect; and in this case a large stem is generally formed, quite in proportion to the massy top. At first the branches of the ash grow from the body of the tree at an acute angle; but the branches, as they increase in weight, incline gradually to hang down towards the extremities, giving the tree, when of mature age, a very graceful outline.

377. There are instances of the ash attaining a very great size. There is one I believe still growing at Carnoch House, in Stirlingshire, said to be about ninety feet high, with a circumference of thirty-one feet at the ground; and upon the estate of Arniston there are ash trees fifteen and sixteen feet in circumference. But trees of such large dimensions are not numerous; neither is it necessary that the ash should attain such a large growth, considering that smaller trees always yield much better timber. A peculiar characteristic of this tree is, that the quality of the wood is always the better from being rapidly grown; at least in so far as regards its immediate use, it being always increased in toughness of fibre by the rapidity of its growth (but perhaps not in the durability of its timber), the opposite of which is the case with most other trees. I have often had occasion to observe, in the cutting up of ash timber, that the wood of trees which grow upon very poor soils, and which of course had grown slowly, was brittle in the grain; and I have been informed by carpenters, that when such wood is used for any purpose, it is much sooner affected by rot than the wood

of trees grown with moderate rapidity upon a good soil; but where the growth has been maintained vigorously throughout, the timber will be found tough, elastic, and durable; and this more particularly if it has been freely exposed to the air, and not drawn up too much in the heart of a plantation.

378. There is none of our forest trees the wood of which can be applied to so many different useful purposes as that of the ash. As to its toughness and elasticity, no tree grown in our woods can be compared to it. As an example of this property, it is only necessary to look to the articles made from it by the sievewright and the basket-maker, in whose hands the ashwood bends like a piece of wire.

No wood can answer the purpose of handles for agricultural and other implements so well as the ash. The coach-maker and the wheelright could not have it properly replaced in their business by any other of our home timber; nor is any wood so well adapted for boat-oars. For all these purposes tradesmen find the wood in its best state when from forty to sixty years old; but this of course must in a great measure depend upon the nature of the soil upon which it may have been grown. In general cases, however, I have observed, that an ash-tree much above sixty years old has considerably lost its toughness, and is not commendable for purposes requiring elasticity, unless, indeed, the soil on which it grows is of a strong loamy nature, and well adapted to the tree.

379. Next to the larch, I consider the ash the tree which comes in to pay the planter at the earliest date. I have myself cut down young thinnings of ash under thirty years of age, for which I received 2s. 6d. per foot for handle wood; and I may observe, that ash in its young state is equally answerable for handles as the tree of sixty years of age; this being a particular property of the wood. There is no sort of coppice-wood more profitable at the present time than that of ash. I have sold young ash-suckers, of two years old, for 1s. 6d. per hundred: these were used for baskets, crates, and barrel-hoops: and from a coppice of seventeen years old, I have taken a vast number of pick-handles—which at once shows that the ash, as a coppice-wood alone, is a very profitable timber, in which form it is in many districts of England much cultivated, it being there cut over at stated intervals and sold for walking-sticks, hop-poles, hoops, crates, hurdles, handles, &c. &c. In order to keep up a supply for these different purposes, which of course require different sizes, the coppice plantations are laid off into separate portions, each portion being cut over at a certain period as may be found to answer a demand for a certain purpose.

I have calculated that, upon the estate of Arniston, where coppice sells but moderately as compared with many districts in England, an acre of ash coppice at four years old, from the stool, is worth £12, making the value of the crop per acre, per annum, £3; and that upon a soil of very moderate capabilities. None of our forest trees make so good fire-wood as the ash; and, what is remarkable, it burns well, although wet and full of sap.

380. The foliage of the ash is of a beautiful light-green colour, and is what is termed by botanists *pinnate*, or winged; and each leaflet is *lanceolate-oblong*, tapering to a point, and *serrated* upon the edges. (See Fig. 61.)

FIG. 61.

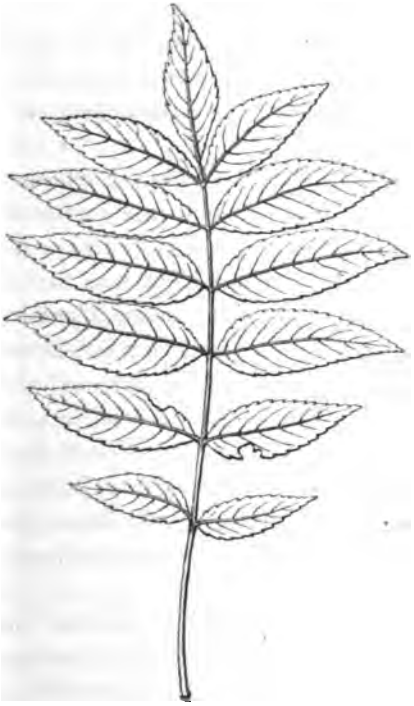
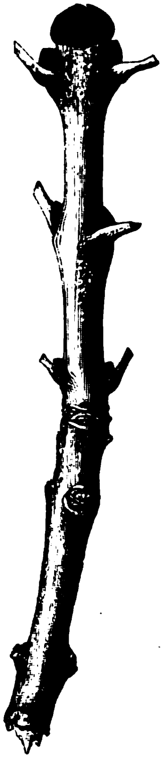


FIG. 62.



The young shoots are *flattened*, of a very brittle texture, and are furnished with very prominent dark-coloured buds. (See Fig. 62.)

381. The ash is propagated by seeds, which are enclosed in what is termed *samaras*, or keys, which are generally ripe for gathering in the month of October. When gathered for the purpose of sowing, the seeds should be mixed with a quantity of dry sand or light dry earth, in which they should be kept all winter, in order to rot off the outer coat; and in order the more effectually to insure this, the whole mass of seeds and sand should be turned several times during the winter. In March, the seeds

should be sown in rows rather thinly, as they are sure to come up thickly and confine one another if this point be not attended to. In the following spring the plants will be ready for being transplanted into the nursery-rows, which may be fifteen inches one from another, and five inches plant from plant in the rows. When the plants have stood two years in the nursery-rows, they will be ready for planting out into the forest grounds. The circumstances which are found favourable to the healthy and full development of the ash, are, as regards soil, a good strong loam, rather rich than otherwise, and rather moist than dry; that is, the ash does not disagree with a little moisture, provided that this moisture have free and ready access away from the roots, and is not liable to remain in the least degree stagnated. I have often seen the ash of considerable dimensions upon bare rocks: in such cases the roots of the tree get into the seams of the rock, and are watered by the moisture which descends between the strata.

382. Until I turned my attention very particularly to the different soils most suitable to the growth of the different species of our hardwood trees, I used to think that ash, and indeed any other hardwood tree, would not succeed to any profitable purpose upon a moss soil. But now that I have examined plantations upon very many estates, I find that ash, as a coppice, succeeds well upon a soil of very deep moss. I have never, indeed, seen the ash attain a good timber size in a moss soil; but as coppice, cut down at periods of from ten to twenty years, I have seen it in excellent condition there; and when not allowed to remain uncut above fifteen years, the parent stocks keep in very good health, and will produce many crops in succession; but if allowed to grow uncut to a period much beyond fifteen years, the stocks are very apt to become exhausted, and fail to produce a profitable return.

Another point relative to this is, that I have observed that, if ash be planted upon a moss soil, in an exposed situation, it will not succeed well even as a coppice; but if the situation be one moderately sheltered, the success will be good. This suggests to us that, in order to convert a moss into a profitable ash coppice, it is only necessary to produce shelter by having the moss ground surrounded by other trees; and if a few spruce firs, which also grow well in mossy soil, be planted among the ash to act as nurses, the coppice will be got the sooner to succeed. The ash is fonder of shelter than most of our hardwood trees, although I do not mean to say that the ash is not a hardy tree; I mean that, in order to have it of tall and large dimensions, it is necessary to give it a sheltered situation; for when on an exposed site it is more apt to become branchy and large-topped; therefore, to grow it well, it is an advantage to plant in a glen or hollow, or in the interior of a large plantation. Many object to the ash being introduced into a forest among other trees, because they say that it is so apt to lash other trees by its branches and top; but from this I have never seen any evil arise. And it is my opinion, that even among oaks, which may be planted as a permanent tree, the ash answers well as a secondary—being, when thinned out from among the oaks under thirty years old, of infinite advantage for many purposes, and, moreover, paying well.

SECTION IV.—DESCRIPTIVE CHARACTER OF THE ELM: ITS HABIT AND PECULIARITIES.

383. The Elm (*Ulmus*) belongs to the natural order ULMACEÆ; and according to the LINN. SYSTEM, to *Pentandria Digynia*. The descriptive character of the genus, according to Don, is: Flowers in lateral groups, proceeding from peculiar buds, and protruded before the leaves; bisexual; monœcious. Calyx reddish, distinct from the ovary, top-shaped or bell-shaped, of one piece, but having 5 or 4-8 segments, which imbricate in æstivation; remaining until the fruit falls. Stamens as many as the segments. Style short or wanting. Stigmas two, acuminate. Fruit a samara, with a membranous wing.

384. There are several species of the Elm, from the dwarf sort, *Ulmus-pumila*, a native of Siberia, which grows only two feet high, to the *Ulmus Campestris*, or English elm, which often attains the height of one hundred feet. There are also several species, natives of North America, which are timber trees of an inferior size, and are not cultivated in Britain for the sake of their timber, but merely kept in the shrubberies as ornamental plants.

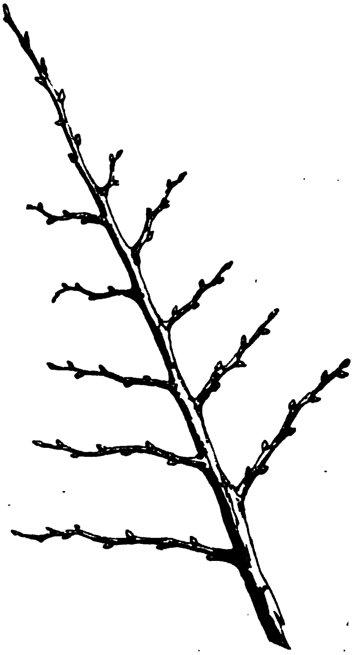
Sir J. E. Smith enumerates five species of our British elms—namely, *U. Campestris*, *U. Tuberosa*, *U. Major*, *U. Montana*, and *U. Glabra*. But as many botanists differ upon this point, it may be very proper to refer them to two distinct species—*Ulmus Campestris*, and *U. Montana*; the rest being merely varieties of these two distinct species. Therefore we will commence our observations with the *U. Campestris*, or English elm.

385. The specific character of this tree, according to Smith, is: Leaves doubly serrated, rough. Flowers nearly sessile, four-cleft. Samara oblong, deeply cloven, glabrous.

386. It is a timber tree of the first magnitude, and supposed by some a native of England, where it is found in great perfection, adorning the parks and lawns of proprietors. It is also a very common hedgerow timber in

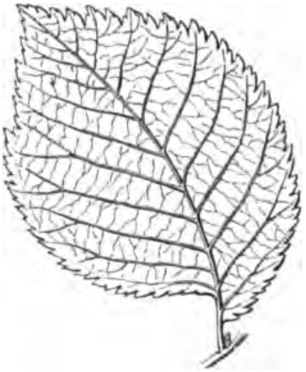
many parts of England; as, for instance, in the valley of the Severn, where it may be seen in great perfection. It is generally admitted to be one of the tallest and finest of our European timber trees for park scenery, and lives to a considerable age. There are a number of them upon the park at Arniston considerably above one hundred years of age, and some of them containing above one hundred and fifty cubic feet of timber. However, it appears to me that the most profitable age of the tree for timber is, generally speaking, from eighty to ninety years: the wood of the tree is then in its best condition, and after that age it will not increase materially in the bulk of its timber. The English elm is of a tall, straight habit of growth, generally maintaining that habit to the very top of the tree, and by no means apt to spread out into large limbs, as is the case with the *U. Montana;* and this constitutes its fine effect when grown singly upon a lawn. However, I have seen instances of this tree spreading very much to branches, particularly if it be grown upon an exposed situation; and I may refer to one upon the lawn at Arniston, which contains nearly two hundred cubic feet of timber, which rises with a bole only about eight feet high and four feet in diameter, and then diverges off into branches of large dimensions, making a tree of most picturesque beauty and singular appearance, but out of character of the general habit of the species, and more resembling a massive oak at a distance than an elm. The English elm is a rapid-growing tree, and frequently reaches the height of eighty feet in as many years. I am surprised that this tree is so little cultivated in Scotland: indeed there exists a strong prejudice against the quality of its wood, which in Scotland is reckoned inferior and worthless as compared with the Scots elm, or *U. Montana;* and, for many purposes, this must be admitted to be the case. I have sold it in Edinburgh, where I could not get more than 1s. 6d. per foot for it; while for Scots elm of the same age I readily got 2s. 3d. per foot. The reason that wood merchants give for the low value set upon the wood of this tree is, that it is what they term *cross-grained,* or, in other words, it is not tough in longitudinal fibre: this is decidedly the case as compared with the Scots elm, and indeed constitutes the most striking difference between the wood of the two trees; that is, the wood of the English elm is particularly strong in what is termed lateral fibre, but deficient in longitudinal adhesion of fibre, while the Scots elm is the contrary; and in this peculiarity the Scots elm resembles the quality of the wood of the ash more than any other tree, being easily split up longitudinally. During my own experience as a forester in Scotland, I have never been able to sell this sort of wood to any extent, although I have frequently had it for sale; the only purpose to which it is applied in Scotland being in the making of blocks, and naves for wheels. From its great length it is very frequently used in England for the keels of large ships, as well as for country purposes in general; and indeed, there it is a great favourite for its timber, as well as for its ornamental appearance.

FIG. 63.



387. The English elm is easily distinguished from the Scots by having the young shoots of a slender form, and those of the last year springing alternately upon each side of the preceding young shoots. See Fig. 63. The leaves also all spring from the young shoots in an alternate manner; and when these are off in the winter season, the weak, slender, and regular appearance of the young wood contrasts beautifully with the rugged appearance of the bark upon the old wood, and gives the branches altogether a light and airy appearance. The leaves (Fig. 64) are small as compared with those of the *U. Montana:* they are doubly toothed or serrated, rough and hard to the touch, and of a beautiful dark-green colour, and unequal at the base, which is a particular characteristic of all the different species of the elm. It is very seldom that this tree ripens its seeds in Britain, that occurring only in favourable seasons. For my own part, I have never seen it ripen its seeds in Scotland, which to me, at least, is an evident proof of its not being a true native of Britain, as many suppose.

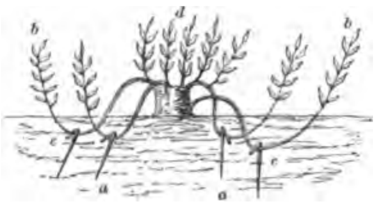
FIG. 64.



388. As the English elm very seldom ripens its seeds in Britain, the tree is propagated by suckers from the roots of old trees, which are had in abundance, or by layers, which is the method by which the best plants are procured, and is the plan adopted in all public nurseries for the propagating of this tree. And in this place it may be proper to show how the work is done.

The process of layering consists in having, first, a piece of ground planted at about six feet apart, with plants of the English elm, or any other tree that it may be desirable to propagate in this way. When these have stood for two, or perhaps three years, in order to gain sufficient strength, they are cut over to within three or four eyes of the ground, in the same manner as a bed of *osiers* when the eyes have pushed out shoots of one year's growth. They are in the autumn, when these shoots are ripe, fit for layering. In layering the shoots which are meant to become young plants or trees, all the ground round about the plants is finely dug, and made perfectly clean from weeds of every description, all stones being also taken out. When the ground has been thus prepared, the young shoots are bent down regularly round the parent stool (see Fig. 65) into the earth, and are kept in their place by small wooden pegs *a a*, and covered with soil about four inches deep at the part bent into the ground. The top part of each shoot *b b* is turned up in an upright direction out of the soil, and in a few months the part which is buried in the soil *c c* takes root, when of course each shoot becomes a perfect plant in itself, and may be removed in the autumn following with all the fibrous roots attached, when they are planted out into nursery lines, in order to gain more strength before being put out into the forest ground. Great care must be observed in cutting away the young and newly-rooted plants from the parent stem; and before the spade is put into the ground in order to loosen their roots from the soil, they should all be cut away from the parent by using a sharp knife, taking care not to pull up the shoot in the act of cutting. When the young plants have been all taken away, the stools should have all the stumps of the branches which were cut off taken away, and young shoots will proceed from the cut parts the following spring, which again will answer for layers in the autumn, as at *d*: this process goes on successively; each summer's shoots which rise upwards are in the autumn laid down in order to become new plants; and while these are in the act of making roots, the parent stool is again employed sending up a new supply of shoots to succeed them. A particular point to attend to in the raising of young trees by layers is to keep the ground particularly clear of weeds; and when a severe drought sets in, the ground should be liberally watered, in order to encourage the rooting of the young plants. This tree, on account of not ripening its seeds in this country, is always sold at a high

FIG. 65.



price as compared with our other forest trees, which is a great reason why it has never been extensively planted in Scotland, even laying aside the prejudice that exists as to the quality of its wood. It is seldom introduced as a forest tree into any of our profitable plantations in Scotland; for although it is of an upright habit, and would answer well as a nurse among others, its place in that respect is better and more profitably occupied by the larch, which is a wood much sought after, and which will pay the planter better than any other tree when used as a temporary nurse.

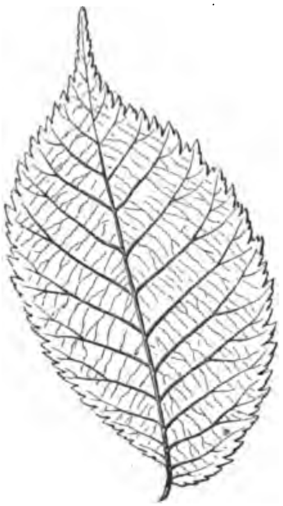
389. The English elm is not a tree that requires a rich soil to bring it to a large size. I have seen it of considerable dimensions upon a very light gravelly soil; and I have also seen good trees of this species upon a strong clay; but a strong sandy loam appears to be the soil in which the tree attains its greatest dimensions.

390. The *Ulmus Montana*, SCOTS OR WYCH ELM. The specific character of this tree is thus stated by Smith: Leaves pointed, rough, broad, and doubly serrated. Flowers on longish peduncles loosely tufted, 5–6 cleft. Samara somewhat orbicular, slightly cloven, naked. Branches drooping at their extremities; their bark smooth and even.

391. It is without dispute a native of Scotland, and, indeed, of Britain generally. It is found delighting in deep glens, among decaying rocks, by the sides of water-courses, where it forms trees of the first magnitude. This tree, when left to itself in an open park or lawn, forms one of the most picturesque and beautiful imaginable. It may, indeed, often be surpassed by its neighbour the English elm, in regard to its height and cleanness of trunk; but it cannot be surpassed in the general effect of its out line. It in all cases stands unrivalled upon the lawn, its appearance being altogether natural, light, and easy. The English elm has a stiff, unbending outline: the Scots elm is the opposite of this.

When not confined by its neighbours, the Scots elm forms a large-headed spreading tree, having its limbs strong and diverging, which gives it a magnificent appearance among other trees of a more stiff character; and when the tree has arrived at full maturity, the branches, from their great weight, incline to hang down in a drooping position at the extremities, forming rich festoons when in full life. This is the habit of the tree when grown upon an open park, with free air to develop its branches; but in such a position it seldom attains to its greatest height and magnitude as a timber tree. When grown in the forest, and where it has not so much free room to extend its side branches, its diverging habit is checked; but in such a position we almost always find it contains the greatest quantity of available timber, and forms a tree of first-rate magnitude. There is one particularly good tree of this sort upon the lawn behind Arniston house, which has arrived at full maturity, and has been rather drawn up in its growing state among other trees. It is eighty feet high, and three feet four inches diameter, six feet from the ground; and contains about two hundred cubic feet of timber.

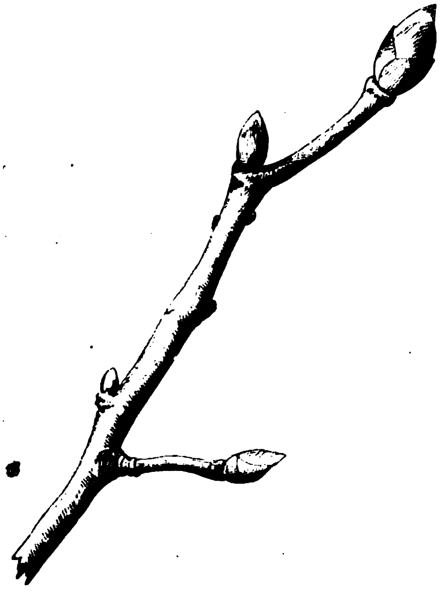
FIG. 66.



392. The Scots elm is easily distinguished from the English by the greater size of its leaves: these are what is termed by botanists *rough* and *broad,* with a longer point, and are more deeply *serrated* than in the other species : (see Fig. 66.) The size of the leaves of this tree vary much according to the healthy state of the plant. I have very frequently seen them seven inches long from base to apex, and this occurred upon trees growing in a deep rich loam; but in general cases the leaves are not more than from three to four inches long, and, when handled, feel rough and rather bristly.

393. The young shoots are much stronger, and altogether more massive than those of the English elm (see Fig. 67), and are slightly downy. Another distinguishing character of the Scots elm is, its producing no suckers from its roots, which all the varieties of the English elm constantly do ; by this it is easily known, independent of any other peculiarity. However, we often see trees of this species send up shoots from the junction of the stem and the roots ; but these are not suckers, properly speaking. Suckers are shoots which are emitted from the roots at a distance from the stem of the tree; and I merely advert to this in order that my meaning may not be misunderstood. Those trees of the Scots elm which have shoots rising from

FIG. 67.



the junction of the roots and stem, are generally in a bad state of health; such shoots are, in fact, a symptom of disease.

394. In Scotland the wood of this tree is much sought after for all country purposes; such as cart-trams, plough-beams, cart naves, wheel-barrow and cart framing, &c. &c.; indeed, there is scarcely a purpose to which ash is generally applicable, for which elm is not used instead when that wood cannot be got conveniently; and for these it is well adapted from the toughness of its longitudinal fibre. At present, while so much handle wood is daily in demand for railway purposes, I have sold very much of it in the form of pick handles, for which purpose it is reckoned equally as good and as durable as the ash; except that, from the wood being hard and closer in the grain than the ash, the workmen complain of it, when made into handles, as being bad for their hands, the friction of the wood causing them to blister; but I have never heard any complaints from the contractors as to the wood not answering well as a handle in place of ash. When converted into this purpose at our saw-mill, we get 3s. 6d. per cubic foot for the wood, which, let it be understood, is only young thinnings of six inches diameter, cut up roughly at the mill for the purpose. The Scots elm, from the close adhesion of its longitudinal fibre, is well adapted for any purpose where a severe cross strain is necessary, such as beams upon which a great weight may have to be placed; and indeed it is often used for different purposes in ship-building, particularly for the floor timbers: but as a wood where long endurance may be required, it is by no means suitable; and however good it may be as a tough wood for many country purposes, it is by no means one that will last long, particularly if exposed to the vicissitudes of the weather. This deficiency of the Scots elm I have often had occasion to observe, more particularly in the case of gate-posts; and in this respect I am, from experience, now aware that it is much inferior to the *U. campestris*, or English elm, taking the two at the same age. Again, as a post for a fence, I have found the Scots elm, in its young state, very little superior to the beech, the wood of which is proverbially of short duration when much exposed. Still, however, the Scots elm is, when of good age, a very useful wood, and adapted for a great variety of purposes; and when used for a purpose where the wood can be kept painted, it will last a long time; but even when so treated, I am convinced that it is inferior to *U. campestris*. As I am aware that there are many who say that the *U. montana*, or Scots elm, is in every respect superior to the *U. campestris*, or English elm, I may state farther, that the quality of both depends to a great degree upon the nature of the soil and situation upon which they may be grown.

When either of them is grown in a low-lying, sheltered situation, and upon a heavy, yet dry and deep soil, they attain their greatest bulk as timber; but then the wood of trees grown in such a condition is generally brittle, and is soon affected by *rot;* in fact, few elm trees grown in such a condition are found sound in the heart if they have attained any considerable age. Where the elm is found growing in a low sheltered situation, and upon a light, deep, and rather moist soil, the tree grows very rapidly, and attains its greatest perfection as a tall, spreading, ornamental tree; but under such conditions it seldom lives long, and generally is found to die suddenly when rapidly grown, unless, indeed, its roots may get into the banks of a stream: in this case it will thrive well and live long in almost any soil, provided that there is no stagnant water about the roots. The Scots elm, in order to have it in greatest perfection as a timber tree, requires to be grown in a soil where it can have a constant supply of fresh and pure water percolating through the soil: such is the case upon the steep banks of rivers; and if the tree has been grown to a large size under these circumstances, and the water be suddenly drained off the ground upon which it is growing, the tree will immediately fall into bad health, and will very possibly die suddenly; this I have frequently observed.

Another peculiar circumstance attending elm trees grown in a sheltered place and upon a light soil, is, that they are generally found what is termed "shaken;" that is, the heart wood of the tree is all split into longitudinal pieces; consequently the wood of such trees is of little value. In situations twelve hundred feet above the level of the sea, I have seen good elms growing upon a light and rather sandy soil; but at the same height, when the soil was inclined to clay, I have always seen the elm assume a low, spreading habit, and very apt to become knotty, and of little value as regards its timber.

The circumstances which appear most favourable to the healthy growth of the Scots elm are, a light loamy soil upon a dry bottom, rather deficient in vegetable matter, which would produce too keen an excitement in the growth of the tree, a free exposure to the air, and a situation upon a slope rather than upon a level, where a regular supply of moisture is likely to be. Generally speaking, the English and Scots elms will both thrive nearly alike under the same circumstances; but the Scots elm is more inclined to a light soil than the English is.

395. The Scots elm is not a tree that should be planted among other hardwood trees in a forest, unless, indeed, it may be meant to stand as the ultimate crop. From its spreading habit it is very apt to hurt other valuable trees; therefore, in planting this tree in any plantation, either plant it in a mass by itself, with firs to act as nurses for a time; or if it should

be wished otherwise, for the sake of young thinnings, plant it but sparingly among others, and cut it away timely as the others advance.

396. The Scots elm is propagated from seed, which is found very plentifully upon old trees from the middle of May to the beginning of June. The seed being very light, and easily blown about by the wind when fallen, it should be gathered by the hands from the tree, and not allowed to fall; and when it is gathered, it should be sown immediately, as it will not keep long. It should be sown in rows fifteen inches apart in the nursery, upon a fine light soil, and should not be covered to a greater depth than half an inch. The seeds spring up very freely and quickly, and will be ready for planting out into nursery rows in the following spring: in planting them into rows, there may be twenty-four inches between each, and the plants may stand in the rows about four inches one from another. When they have stood two years, they will be ready for the forest ground.

SECTION V.—THE BEECH: ITS HABIT AND PECULIARITIES.

397. The beech (*Fagus*) belongs to the natural order CORYLACEÆ; and according to the Linnæan system, to *Monœcia Polyandria.* According to Don the character of the genus is: *Male flowers* in stalked drooping heads or capitate catkins, three or four in each, attended by minute deciduous bracteas. Each flower consists of a 5-6 cleft bell-shaped calyx, and 8-12 stamens, that arise from the bottom of the calyx and extend beyond its mouth.—*Female flowers,* borne 2-6 together, within a pitcher-shaped indistinctly four-lobed involucre, constituted of numerous unequal bracteal scales, and interior scales, grown together. Each flower consists of a calyx, lengthened into a laciniate limb, and investing the ovary. Fruit nuts.

398. There are several distinct species and varieties of the beech in our nurseries, and in cultivation, a few of which are very ornamental in our shrubberies, particularly the purple and fern-leaved varieties; but the only species which is worthy of our notice here, is the common beech, or *Fagus Sylvatica,* the specific character of which is, according to Willdenow: Leaves ovate, glabrous, obsoletely dentate; ciliate on their margins.

399. This tree is generally reckoned a native of Britain; and, indeed, it is found growing naturally in many old plantations, particularly in Dorsetshire and Berkshire in England. In Scotland, its being indigenous is doubtful; but in old woods in Scotland where it has been planted, young trees rise up most freely. Large plantations of it have been made by the Earl of Fife in Morayshire, where it grows most luxuriantly. The beech

is one of the most hardy of all our hard-wood forest trees. In Devonshire, which is much exposed to severe west winds, no tree appears to stand better, and that in high exposed situations upon a poor thin gravelly soil.

In many high-lying parts of Scotland, where even the Scots pine has failed upon a thin gravelly soil, I have seen the beech grow, and make an excellent shelter, and that near the sea-shore; which points out that it makes an excellent tree for planting along the sea-shore as a protection for the more valuable forest trees.

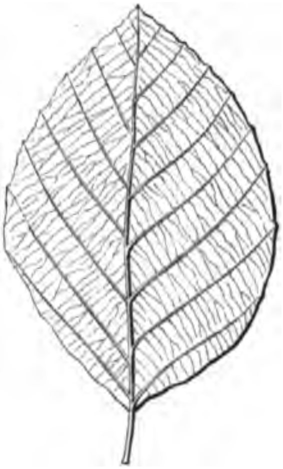
400. Besides the useful property of being a hardy tree, the beech is also an extremely ornamental tree, and is often found of dimensions far surpassing the oak. It rises generally with a clear stem or bole, with massy branches spreading almost horizontally; and when in full leaf, the tree has altogether a light and airy appearance, contrasting beautifully with the sycamore or horse-chestnut, which have a heavy sombre aspect. In duration as a tree, the beech is much inferior to the oak, sycamore, or chestnut; but in this respect it may be classed with the elm and ash; and I could point out many beech trees about two hundred years old still in good health. Upon the estate of Arniston there are now growing many fine old beech trees of large dimensions, several containing above two hundred cubic feet of timber.

401. The beech is not considered a valuable timber tree, although it has a strong massive appearance. The wood is very brittle and short-grained, and not well adapted for purposes where strength and durability are required. At one time the wood of the beech was much used for machinery, particularly by millwrights; and, indeed, a good deal of it is used by them still for cogs to water-wheels. But since the extensive use of iron in all machinery, the beech is little used for that purpose; and seeing that it is not a wood in demand, it cannot be recommended as a profitable forest tree. The wood of the beech, when in a young state, is proverbially of short duration. I have frequently used it for paling posts, and found these not to last above two years; therefore it should never be planted as a nurse, to be cut down as thinnings in a young state, for no tree is then less profitable. However, the beech-wood, when kept constantly wet, is remarkably durable; as is the case when it is made into water-wheels; but if it is kept constantly dry, as in the case of roofing in a house, it lasts but a short time as compared with many other sorts of timber.

402. Since railway operations have been carried on to a considerable extent, I have been able to sell very large quantities of beech at 1s. 6d. per foot. Railway contractors use this wood for making their waggons and temporary sleepers, for which it answers very well. Beech is yet much used for the following purposes:—Common bedsteads, panels of carriages, car-

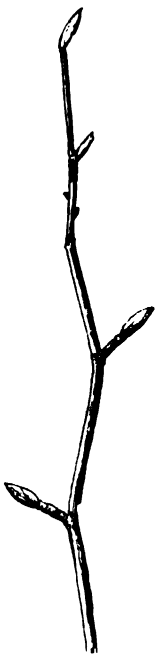
penters' planes, masons' mells, wooden bowls, granary shovels, and many small articles in turnery. It also makes excellent firewood. Upon the estate of Arniston I have made a considerable quantity of charcoal from the beech, which I sold to colour manufacturers. The tops or smaller branches are also much sought after for the curing of herrings; and I may also observe, that as a sole for draintiles in moss land, nothing is so suitable, it being extremely durable in moss.

FIG. 68.



403. The beech is a tree easily known from any other in the forest by its smooth bark and light-green silky leaves. The leaves are what is termed *ovate* and *obsoletely dentate,* being fringed on the margin. (See Fig. 68.) The beech in its young state keeps its leaves all winter, and they do not fall off till the sap rises in the tree in the month of April, when they are replaced by the new leaves. I have observed that young beech trees generally retain their leaves all winter till they are from twenty to twenty-five years old, when they drop them in the winter like any other deciduous tree; but if the beech be kept cut down in the form of a hedge, it retains its leaves all winter, so long as the plant exists in a healthy state. I could point out beech hedges fifty years old, which retain their leaves the whole year, while trees of the same species and of the same age, and in the same neighbourhood, lose them;—a remarkable feature in the nature of the tree, and one which characterises the beech as the best of all plants for a hedge where shelter is the object.

FIG. 69.



404. The young shoots of the beech are numerous upon the larger branches, and are rather slender in appearance, and of a somewhat brittle texture. (See Fig. 69.)

The beech is of a slow growth for the first three or four years after being planted, and is indeed rather of a shy nature to come away at first, unless, indeed, the soil be particularly dry and favourable for it; and if there be much damp retained in the soil in which it is planted, the young trees will in most cases die altogether; but where the soil is dry and open, as soon as the plants have got their roots established in the soil, they grow with extraordinary rapidity, and soon become trees of considerable dimensions.

405. The beech is propagated from the seeds, or *nuts*, which are well known: these are gathered when they fall from the trees in the months of October and November. Some foresters sow the nuts immediately in beds when they are gathered; but in my opinion this is a bad plan,—at least I have found it to be so; for when sown in the month of November, and lying in the earth all winter, the seeds are exposed to the attacks of mice and other vermin, which thin them very much, and of course cause a great deal of extra trouble in preserving them unhurt. My method is, to mix the seed when gathered, with a quantity of dry sand, previously prepared, and allow it to lie in that state till the month of March, when it may be sown upon a light soil, and covered with about an inch of earth; and in this state the seeds will vegetate quickly, and be free from injury from vermin. The plants require to remain two years in the seed-bed before being transplanted out into nursery rows, which may be done any time from November to March when the weather is open. The distance between the rows in the nursery may be about two feet, and the plants may be put in about four inches one from another, if they are to be raised for hedges; but if meant for the forest ground, they should have six inches one from another, in order to make them more hardy and robust to stand upon an exposed situation. When the plants have stood one year in the nursery rows, they will answer well for mixing among thorns in a young hedge; but if intended for forest trees, they will require to remain in the nursery rows at least two years, by which time they will be well rooted and strong bushy plants.

406. The beech is a tree which, from its accommodating habits, is well fitted for growing in a forest among others: but, on account of the little value now set upon its wood, it is by no means proper that it should be extensively introduced among other more valuable trees, particularly if the soil be adapted for others of more value. However, few trees suffer less from bad management than the beech; although it may have been overburdened and crushed down among other trees, yet, when it is once relieved, it will shoot up again, and in a few years make good its position among its neighbours.

In modern forestry the beech is not a tree for a permanent crop, unless indeed upon a poor soil where nothing more valuable would grow, where it would at best make a respectable cover or shelter: and as a nurse, its place is always better occupied by larch, Scots pines, or spruce firs.

I have frequently had occasion to observe upon poor, thin, sandy soils, and upon a high exposed situation, where, indeed, scarcely any other hardwood tree could make any respectable progress, that the beech had attained a fair size of timber; and in such situations the firs, which had been intended to nurse them, had died out, the soil being almost a pure sand or gravel: this points out that the beech is more to be depended upon than even the fir on a poor soil and high site. In a moderately high-lying situation, upon a dry bottom, with a free circulation of air, the beech lives to its greatest attainable age; and in a low situation, with a good soil and humid atmosphere, the tree reaches its greatest size; but in such a state it generally dies quickly after attaining maturity.

407. The circumstances which appear most favourable to the healthy development of the beech, are a dry and rather light soil, having a considerable proportion of lime or chalk. Notwithstanding that we generally find the beech luxuriating and forming its best quality of timber upon a light and friable soil, I have often had occasion to remark healthy plantations of this wood in almost all sorts of soil. I could point out upon many estates excellent beech timber growing upon a stiff clay soil, and also good timber upon a very light sandy soil. This accommodating nature of the tree seems to be the reason why we so often see at the present day so many old beech trees about the seats of proprietors both in England and Scotland.

SECTION VI.—THE GREAT MAPLE OR SYCAMORE.

408. The Maple belongs to the natural order ACERACEÆ; and according to the Linn. system, to *Polygamia Monœcia*. The descriptive character of the genus is: Sexes hermaphrodite, or monœciously polygamous. Flowers with a calyx and corolla. Calyx divided into 5 parts, or some number between 4 and 9. Petals the same in number. Stamens 8, or some number between 5 and 12. Anthers 2-lobed. Carpels 2, very rarely 3; each *a samara*.

409. There are many species of maple—nineteen or twenty—but the only ones I think it worthy to attend to in a work of this kind are, 1st, the Great Maple or Sycamore; and, 2d, the Norway Maple.

410. The specific character of the first mentioned, the *Acer pseudoplatanus*, Great Maple or Sycamore, is thus given by Don:—Leaves cordate, smooth, with 5 accuminated, unequally toothed lobes. Racemes pendulous, rather compound; with the rachis, as well as the filaments of stamens, hairy. Fruit smooth, with the wings rather diverging.

411. This is a tree of first-rate magnitude, and lives to a great age. In Scotland it is more generally known by the common name of *plane* tree. This, however, is the *platanus* of botanists, and is originally from the Levant. When grown under favourable circumstances, few trees live to a greater age than the sycamore. There is still growing in the park adjoining the palace of Scone, in Perthshire, a sycamore said to have been

planted in the time of Mary Queen of Scots. The tree is at present apparently in perfect health, and must be about three hundred years old; and at several other places I could point out trees of as great age, and seemingly in perfect health.

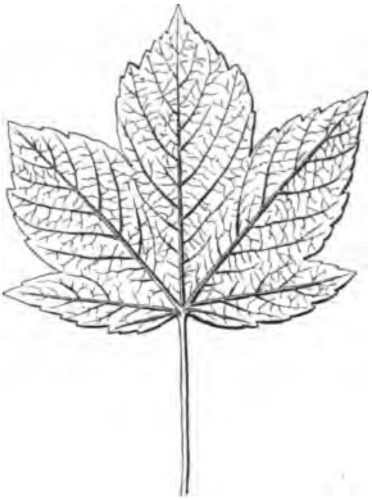
412. Many consider the sycamore tree of a heavy and gloomy aspect, and not fit to be introduced into a park where a lively natural appearance is desired. My opinion is quite of an opposite nature. Only let the fine effect that this tree has upon our lawns and parks about the end of April and beginning of May be considered; it is then that the sycamore appears to best advantage; its light green leaves have then a freshness and a lightness indescribable, and give the park upon which the trees stand quite an oriental appearance. The very circumstance of the sycamore coming into leaf earlier than almost any other tree upon the lawn, makes it a favourite with the lovers of natural scenery; and even in the midst of summer the tree presents a grand unbroken mass of foliage, which contrasts beautifully with other trees of a more airy character, particularly if the situation be prominent. The sycamore is not a tree that carries height along with its girth compared with many other forest trees; and this is particularly the case when it is found growing free in an open park or lawn. In such a situation it forms a short massive stem, with a spreading head of frequently very great magnitude. Upon the lawn in front of Arniston House there is growing a sycamore tree with a stem about five feet in diameter, four feet from the ground. The stem is not more than eight feet high, when it diverges into limbs of large dimensions. The tree is not more than sixty-five feet in height, and contains about three hundred cubic feet of timber, and is at least two hundred years old, and in a perfectly healthy state.

413. The sycamore, when of large dimensions, is a very valuable tree. Some years ago I sold it at 4s. per cubic foot. Now, however, we cannot get much over 2s. 6d. per foot for the like quality of timber. When we sold it at 4s. per foot, there was a great demand for this sort of wood for the print and bleach fields about Glasgow and other manufacturing places; but now that metal is introduced instead of wood for these purposes, it does not, of course, sell so well; but even yet, when of large scantling and clean grown, 3s. per foot can be had.

414. The wood of the sycamore is reckoned of excellent quality, and fit for many purposes; such as tables and other articles of household furniture, mangles, and wooden dishes; and a considerable quantity of it is still used in different parts of machinery. It is also well adapted for heading to herring barrels. For this purpose I sell a great quantity of it, sawn up into small boards, five-eighths of an inch in thickness, and eighteen inches in length. For this purpose, however, a small price is given; but as wood

of small dimensions answers the purpose—generally, indeed, the limbs of large trees—a large price cannot be expected. For some years past, the price of plane-tree heads for herring barrels, five-eighths of an inch thick, has not been more than 70s. per thousand superficial feet, laid down in Leith; and as it takes about sixty-five cubic feet of round timber to produce one thousand superficial feet of sawn heads for barrels, it will be observed that little more than 1s. per foot is received for the round timber, exclusive of the expenses of cutting up and cartage; and, according to calculations that I have made upon this point, even with a good saw-mill, not more than 8d. per cubic foot can be calculated upon for the round timber, after deducting every item of expense in converting it into heading. But as I have already observed, wood of small dimensions answers the purpose: it generally pays much better thus than selling it for firewood.

FIG. 70.



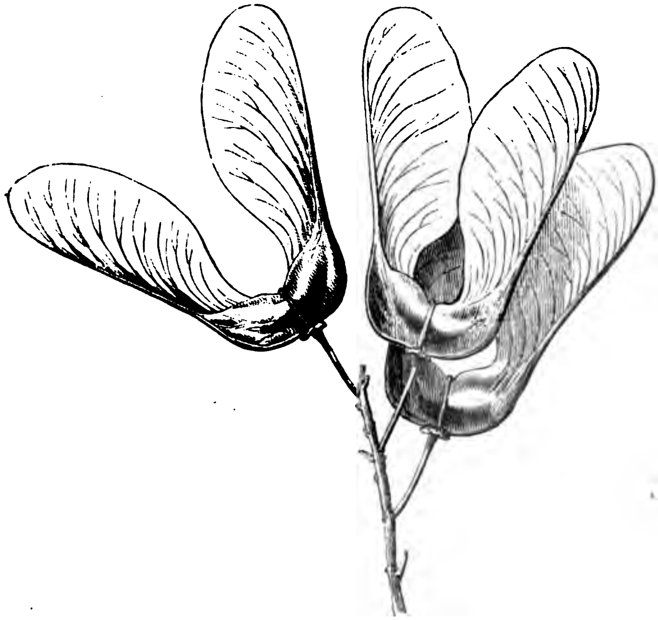
415. The sycamore is very easily distinguished by its beautiful five-lobed leaves; or, as botanists describe them—*heart-shaped*, with five acuminated, unequally toothed lobes. (See Fig. 70.)

The sycamore is propagated entirely by seeds, excepting, indeed, the variegated and other varieties; which are increased by budding or grafting. When the seeds are ripe (see Fig. 71), they should be sown immediately after being gathered, because they are extremely apt to lose their vegetative powers: this may be done about the middle of October; or if it should be preferred to keep the seed till spring, it should be mixed up with a quantity of dry sand, and sown as early as possible in the spring. When the seedlings are one year old, they should be planted out into the nursery rows, where they should remain two years before being removed to the forest-ground. For the distance at which the plants should stand in the nursery rows, see that already given for the ash and elm.

416. One particular point to attend to, in the rearing up of healthy sycamore trees, is the proper pruning of the plants; that is, if the young trees be cut and pruned in the winter or spring months, they are sure to bleed profusely at the wounded parts, and will very probably remain stunted, miserable-looking things for many years after: therefore, when it is found necessary to prune the sycamore, let that be done in the summer

months, or in the growing season of the tree, when, instead of being injurious, judicious pruning becomes beneficial to it, because the sap at this season is quickly formed into proper woody matter, and the wound heals up in a very short time, causing the stem to become strong and healthy by having the sap directed towards it.

FIG. 71.



417. There are few trees more hardy than the sycamore. Mr Loudon speaks of it growing as high as three thousand feet above the level of the sea in Switzerland, where it much abounds; of this hardiness of the tree there is no doubt, for I have myself seen the sycamore in this country attain a considerable size upon elevated spots along the sea-shore, where scarcely any other tree could exist along with it but the pinaster; therefore I recommend it as a most useful tree in all exposed situations, if the soil be dry, and not too much inclined to stiff clay or moss, nor of too light a character, nor of the nature of chalk.

418. The circumstances which are found most favourable to the healthy development of the sycamore are—as to soil, dry sandy loam, with a free exposed situation, as in the open parks about gentlemen's home-grounds.

419. The sycamore, from its being easily checked in the side branches, is well adapted as a nurse for other more valuable trees in a forest. It also makes an excellent coppice-wood, the young shoots growing exceedingly rapidly from the stock, and making from three to five feet of length

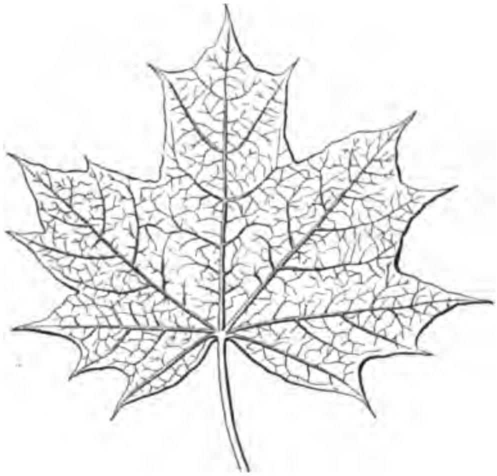
in one season. Being an exceedingly hardy tree, and of a peculiarly stiff and unbending habit, it is well adapted for hedge-row timber; and, moreover, being a tree which comes very early into leaf in the spring, it has the advantage of producing considerable shelter to the fields by its large leaves, as well as giving a healthy and clothed appearance to the country. Many, indeed, object to it as a tree adapted for hedge-row timber, upon account of its wide-spreading branches; and, no doubt, it must be confessed that its wide-spreading branches will, under careless management, cast a great shade upon the land on each side of the hedge-row; but if it be properly trained by judicious and early pruning, it may be made not a wide-spreading tree, but a tall closely-branched one, of the best description possible for producing shelter to the adjoining fields. (See chapter upon Hedge-row Timber.)

420. I shall next refer to the Norway Maple (*Acer Platanöides*) which belongs to the same natural and Linnæan orders as the preceding. The specific character of the tree is, according to Don:—Leaves cordate, smooth, 5-lobed. Lobes acuminated, with a few coarse acute teeth. Corymbs stalked, erectish, and, as well as the fruit, smooth. Fruit with divaricated wings. It is not a native of Britain, but is found very plentifully upon the continent of Europe. Loudon, in his *Arboretum Britannicum*, page 410, says that he observed it "in all woods bordering the public road from Wilna to Mittau, and from Moscow to Gallicia;" and again he says—"Next to the birch and trembling poplar, it seemed to us the most abundant tree in the Russian woods." From the tree being named the Norway maple, it would appear to be found plentifully in that country also, making it as hardy as the pines which are found there: and this is indeed the case; for there are few, if any, of the forest trees introduced into Britain so hardy as the Norway maple.

421. It is a tree of first-rate magnitude, attaining nearly equal dimensions with the sycamore in a given period, and is by far too little cultivated in Britain. The Norway maple, as a lawn tree, is perhaps not surpassed by any other: a particular recommendation of it is, that it comes early into leaf; and in the autumn the leaves of this tree give an extremely rich and varied effect, from their bright yellow colour contrasting with the dark-green and russet tints of the other trees. The form of the tree, although much resembling that of the sycamore, is more open and light, and it does not form so heavy nor so massive an appearance, being easily distinguished at a distance by an outline more natural, easy, and light than the sycamore. I have never as yet had the opportunity of seeing the wood of the maple cut up under my own observation, it being by no means plentiful enough in Britain to be used for common purposes, as is the case with the syca-

more; but, from the specimens of the trees that I have seen pruned, and from articles of furniture that I have seen made of the full-grown wood, it appears to me to be a wood of far more real value than the sycamore, being more close in the grain, and taking on an excellent polish. I am therefore inclined to think that, taking it simply in the light of a timber tree, it is of more value than the sycamore, and may be adapted to many more purposes.

FIG. 72.



422. The leaves somewhat resemble those of the sycamore, but are more acute in the angles. (See Fig. 72.) They are also fully as large as those of the sycamore, but of a lighter green, and more transparent in the texture; and a particular character of the leaves is, that they are never apt to be eaten or injured by insects, as is the case with most other trees; hence they always present a sound healthy appearance. The young shoots of this tree are at first of a greenish colour; but as the season advances, and the wood becomes more ripened, they become of a brown colour, with white spots upon the surface of the bark. In the winter season this tree is easily distinguished from the sycamore by the bark upon the old wood or body of the tree, which is of a brownish-grey colour, the buds being of a deep red, very prominent and large.

423. The Norway maple is propagated by seeds in the same manner as the sycamore, and in every respect the method of culture stated for the sycamore is applicable to this tree; and I may add further, that it bears seed at a very early period. I have gathered good seed from trees of thirty-five years of age, and this in the end of September and the beginning of October.

424. Being a native of the colder regions of Europe, the maple is well adapted, as a useful timber-tree, for British plantations. It is found growing in Norway down to the very sea-shore, and is there found to stand the blasts of the sea excellently—so much so as to become timber of large dimensions; it is, therefore, remarkable that it has not been more cultivated in this country, particularly upon estates along our sea-coast. Upon the west coast of Scotland—as, for instance, along the Galloway shores—I have seen

it thrive well; and from specimens that I have seen growing there, I am convinced that, were its cultivation extensively put into practice, the Norway maple would there supersede every other forest tree; and instead of that barrenness which at present characterises the coast of Galloway all along from the mouth of Loch Ryan to Maidenkirk, a beautiful woodland aspect might be given to the whole, were this valuable tree introduced there as its merits demand. In order the more quickly to bring about this state of things, the Norway maple should be planted at about twelve feet apart, and the ground made up with the pinaster to the thickness of four feet. By this method, the pinaster being an exceedingly hardy tree in withstanding the sea-breeze, the Norway maple would, from being sheltered by it, assume a rapid growth in a very short time; and as they advanced, the pinasters which nursed them could be thinned out gradually, in order to give the more space to the maple, it being meant to remain as the permanent crop.

425. That the Norway maple is a rapid-growing tree is beyond dispute, although many deny this property of it. I could myself, upon many properties, point out shoots of this tree three feet long, with a diameter of half an inch, and that upon young trees not more than twelve years old, which is equal to growths of the sycamore upon trees of the same age. Being well aware of the hardy nature of the tree, I here beg to advise proprietors to plant it plentifully, not in the form of a temporary nurse, but *in* the form of a permanent tree; for I am persuaded that, ere many years pass by, its usefulness will be appreciated, and it will become a very prominent tree in our forests, and more particularly upon high and exposed parts along our sea-coasts.

426. The soil most favourable for the growth of this tree is found to be a free, open, sandy loam; but although under such circumstances it does, no doubt, grow most rapidly, and develop itself to greatest advantage, it will, nevertheless, grow freely upon very inferior soils, provided that such be dry and properly drained; and upon the estate of Dunsky, in Wigtonshire, I have seen young trees make good progress upon a surface of rock, with here and there a little soil, into which the plants were put.

SECTION VII.—THE PLANE-TREE.

427. The plane-tree (*Platanus*) belongs to the natural order PLATANACEÆ; and, according to the Linnæan system, to *Monœcia Polyandria.* There are only two distinct species of this tree introduced into Europe, and as I very much admire them both for their ornamental effect on the park, I

have considered it desirable to give a description of them in the present work. As, however, both species are comparatively scarce in this country, I am not myself sufficiently acquainted with their nature and general peculiarities to enable me to describe them satisfactorily; I shall, therefore, take my description of them from Loudon's *Arboretum Britannicum*. He gives the character of the order Platanaceæ, as follows:—

428. "Flowers unisexual, collected into globose or oblong catkins of different sexes, involucrated, or naked.—Male flower having the perianth composed of numerous small linear pieces, intermixed with the stamen. Female flower with the scales absent, or intermixed with the flowers: perianth adhering to the ovarium, cup-shaped, or ending in small pilose bristles. Carpels, 1 or 2—one-celled, horned at apex, coriaceous. Seeds solitary in the cells, pendulous. Albumen none (G. Don). Leaves simple, alternate, stipulate, deciduous; palmate. Flowers in globular catkins. Lofty deciduous trees, with widely spreading branches, dense foliage, and bark scaling off in hard irregular patches. Natives of the east of Europe, west of Asia, and north of Africa, and of North America. In Britain, they are chiefly planted for ornament, and they succeed in any free moist soil, in a sheltered situation. They are readily propagated by layers, or even by cuttings, and sometimes by seeds. The cause of the scaling and falling off of the bark, Dr Lindley states to be the rigidity of its tissue; on account of which it is incapable of stretching as the wood beneath it increases in diameter."

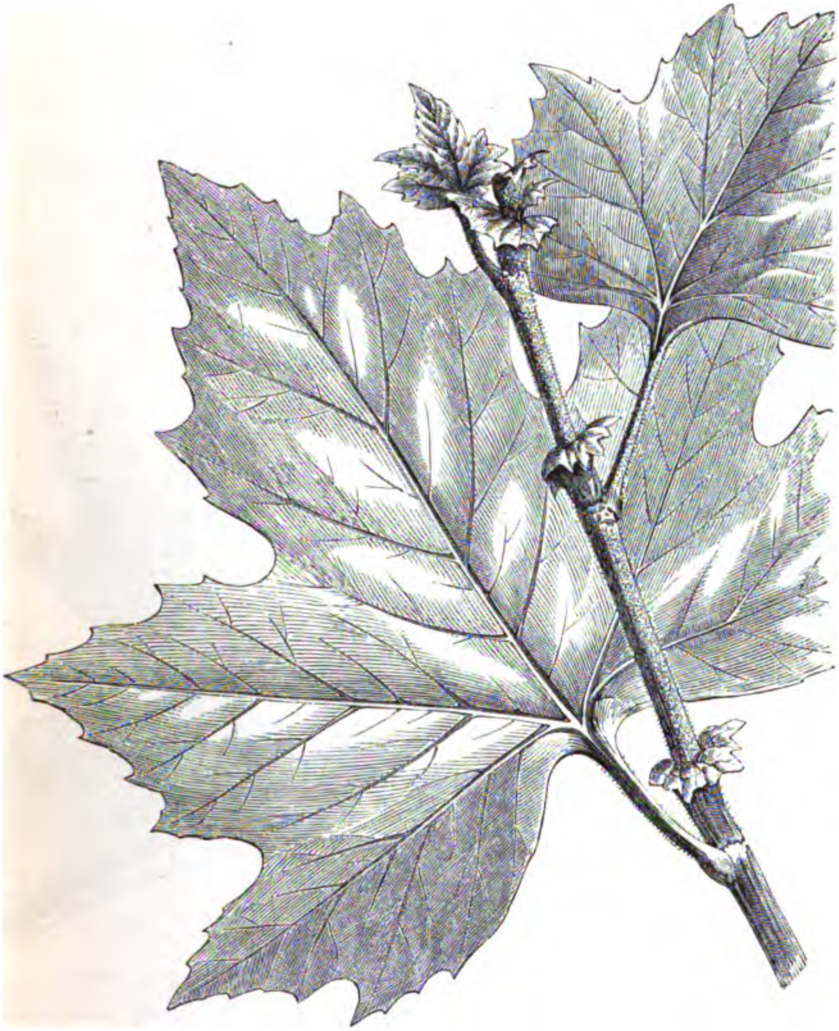
429. "There are only two species introduced into Europe; one of which, *P. orientalis*, is found to be much hardier than *P. occidentalis*, though the latter grows more rapidly, attains a larger size, and may be propagated much more readily by cuttings. Both species ripen seeds in Britain in fine seasons. *P. occidentalis* is readily known from *P. orientalis*, in the winter season, by its bark scaling off much less freely, or, in young or middle-sized trees, scarcely at all; and in the summer season, by its leaves having red petioles, and being but slightly lobed (see Fig 73), instead of being palmate, like those of *P. orientalis* (see Fig. 74), which have green petioles, and by its globular catkins being nearly smooth, while those of *P. orientalis* are rough."

430. He gives the specific character of the Oriental Plane (*P. orientalis*) thus:—"Leaves 5-lobed, palmate, wedge-shaped at the base, the divisions lanceolate, sinuated. Stipules nearly entire. (Willd). A large, deciduous tree. The Levant: height 60 feet to 80 feet; with a wide-spreading head. In British gardens 1548. Flowers greenish yellow; April, May. Fruit brown; ripe in October; persistent great part of the winter.

431. "The Oriental Plane is one of the noblest trees of the East, where

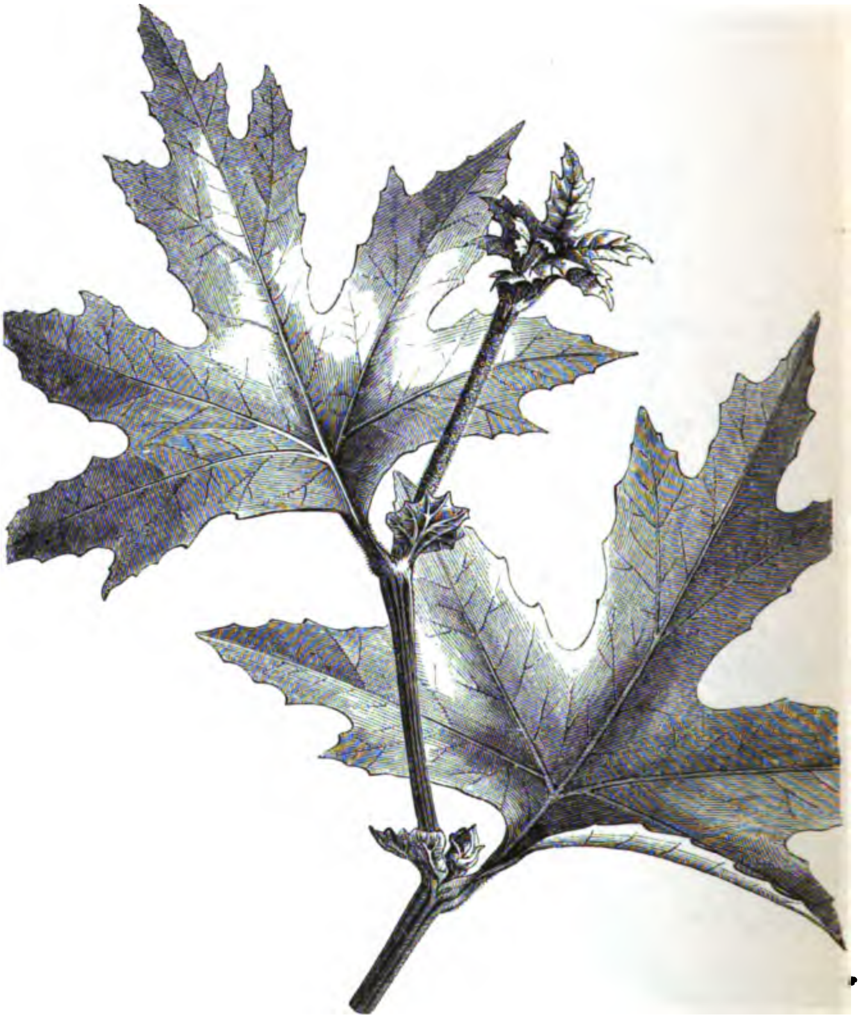
it grows to the height of 70 feet and upwards, with widely spreading branches, and a massive trunk, forming altogether a majestic tree. The wood may be compared to that of the *Acer Pseudo-Platanus;* but very little use is made of it in the west of Europe. Pliny affirms that there is no tree whatsoever that defends us so well from the heat of the sun in summer, or that admits it more kindly in winter. Both properties result from the large size of its leaves in summer; these present horizontal imbricated masses, which, while they are favourable to the passage of the breeze, yet exclude both the sun and the rain; while, as the distance at

FIG. 73.



which the branches and twigs of trees are from one another is always proportionate to the size of the leaves, hence the tree in winter is more than usually open to the sun's rays. As an ornamental tree, no one which attains so large a size has a finer appearance, standing singly, or in small

FIG. 74.



groups, upon a lawn, where there is room to allow its lower branches, which stretch themselves horizontally to a considerable distance, to bend gracefully towards the ground, and turn up at their extremities. The tree, from its mild and gentle expression, its usefulness for shade in summer, and for admitting the sun in winter, is peculiarly adapted for pleasure-grounds, and, where there is room, for planting near houses and buildings. For the latter purpose it is particularly well adapted, even in winter, from the colour of the bark of the trunk, which has a greyish white tint, not unlike the hue of some kinds of freestone. The colour of the foliage, in dry soil, is also of a dull greyish green, which, receiving the light in numerous horizontal tuftings, readily harmonises with the tint of stone walls. It appears, also, not to be much injured by smoke, since there are trees of it of very considerable size in the very heart of London."

432. "A light deep free soil, moist, but not wet at bottom, is that on which the oriental plane-tree thrives best; and the situation should be sheltered, but, at the same time, not shaded or crowded by other trees. It will scarcely grow in strong clays, and on elevated, exposed places; nor will it thrive in places where the lime-tree does not prosper. The plane-tree may be propagated by seeds, layers, or cuttings. The seed should be gathered in October or November; and, the balls being broken by the hand, or by thrashing with a flail, the seeds may be separated from the husks, and cleaned by the usual processes, and either sown immediately, or mixed with sand or fine sandy soil, and preserved in a place secure from frost till February or March. The seeds may also be kept in the balls, or catkins, till spring, either by allowing them to hang on the tree, or by gathering them in autumn, and spreading them out in a dry loft. The general practice is to sow the seeds in autumn, or as soon as gathered, or received from the continent, choosing a moist rich soil, and a shady situation, and covering them as lightly as those of the birch or alder are covered, or beating them in with the back of the spade, and not covering them at all; and protecting the beds with litter of some sort, to exclude the frost. The plants will come up the following spring."

433. *P. occidentalis*, or the Western Plane, has its specific character thus:—"Leaves 5-angled, obsoletely lobed, dentate, wedge-shaped at the base, downy beneath (Willd.) A large deciduous tree. Atlantic and Western States. Height, 70 or 80 feet, with a widely-spreading head. Introduced in 1636. Flowers greenish; May. Fruit brownish; ripe in October and November."

434. "The American, or Western Plane, is of much more rapid and upright growth than the oriental plane, with broader and less deeply cut leaves, red petioles, and fruit comparatively smooth, and considerably larger. The bark is said to scale off in large pieces, and the wood to be more curiously veined. In all other respects, the descriptive particulars of both trees are the same. The rate of growth of *P. occidentalis*, when placed near water, is so rapid, that in ten years it will attain the height of 40 feet; and a tree in the Palace Garden at Lambeth, near a pond, in

twenty years, had attained the height of 80 feet, with a trunk 8 feet in circumference 3 feet from the ground, and the diameter of the head 48 feet. This was in 1817. In May, 1837, we had the portrait of this tree taken, which will be found in *Arb. Brit.*, 1st edit., p. 2044, when it was upwards of 100 feet in height. Uses, culture, soil, &c., as in *P. orientalis*, with this difference, that cuttings root much more readily; that the tree, to attain a very large size, requires a moister soil, or to be placed near water; that it is less hardy, and also less ornamental, though, from being more readily propagated, it is much more frequently planted." I have myself seen many fine specimens of the *P. orientalis;* and even in the north of Scotland they seem to thrive well, as on Lord Seafield's estates we have them 30 feet high, little more than thirty years planted. This is a tree deserving a place in all moderately sheltered districts of the country, and it is indeed a handsome one, and also quite hardy.

SECTION VIII.—THE POPLAR.

435. The Poplar (POPULUS) belongs to the natural order SALICACEÆ, and according to the Linnæan system, to *Diœcia octandria*, and the character of the genus, according to Don, is: *Bractea* to the flower of each sex laciniated in its terminal edge. Male flower consisting of a calyx, and 8 stamens at fewest; in many instances many more. Female flower consisting of a calyx and a pistil.

436. There are several species of this family, which are well adapted for forest timber trees: the sorts which are most worthy of our notice here are the black poplar, *Populus nigra;* the white poplar, *Populus alba;* the grey poplar, *P. canescens;* and we may also add the aspen poplar, *P. tremula*; the Lombardy poplar, *P. fastigiata;* the black Italian poplar, *P. monilifera;* and the Ontario poplar, *P. candicans.* These are all rapid-growing trees when found in a soil congenial to their nature, and attain very large dimensions.

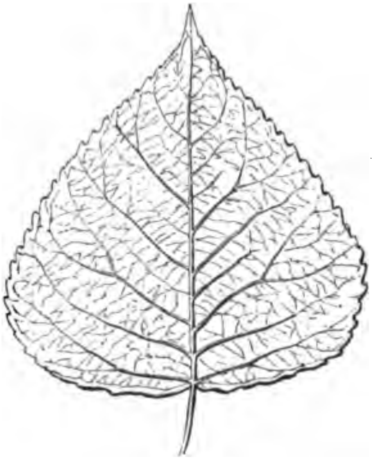
437. I shall begin my description with the first mentioned—viz., the *P. Nigra.* According to Smith, the specific character of the *P. Nigra* is: Petiole somewhat compressed. Disk of leaf deltoid, pointed, serrated with glanded teeth, glabrous on both surfaces. Catkins lax, cylindrical. Stigmas 4, simple, spreading. It is a native of Europe, and found also in the north of Africa.

438. The P. NIGRA is a tree which attains large dimensions of timber in a very short time, but does not endure long when it has arrived at maturity, which may be reckoned at fifty years of age. When planted in a

low-lying situation, where it has the advantage of shelter, it forms a very prominent tree in the landscape; but if planted among trees of a slow growth, it soon overtops all others, and has by no means a fine effect; but where it is planted in a situation adapted to its rapid growth, it forms a magnificent tree, having a large spreading top, with an extremely massive trunk. Upon the estate of Arniston I cut down a tree of this sort, which was only thirty-five years old. It was, when stretched upon the ground, seventy-eight feet in length, and three feet in diameter at the base of the trunk; and, altogether, this tree contained sixty-six cubic feet of timber. It was sold for 2s. per foot; thus giving, as the produce of a single tree in thirty-five years, £6, 12s. This example is enough to point out the advantages arising from planting the black poplar in a good soil and situation. The soil upon which this tree was growing was a sandy loam, in a sheltered situation upon the lawn; and it was cut down in consequence of interfering with an oak near it.

439. The wood of this tree is much sought after by cartwrights for bottoming, and is also used for light turners' work. It is said to be much sought after upon the continent of Europe for wooden shoes, and for making packing-boxes. I have sold a great deal of it for drags for railway waggons, for which purpose it answers well.

FIG. 75.



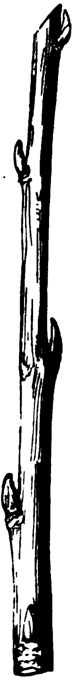
440. Many of the poplars much resemble one another in the appearance of their leaves, but the black is easily distinguished from the others by having its leaves of a pale-green shining colour; their shape is termed by botanists *deltoid,* or trowel-shaped, pointed and *serrated,* and smooth on both sides. (See Fig. 75.) The leaf-stalks of this sort are thin and slender at their insertion upon the leaf, which gives them a vibrating motion upon the tree from every breath of wind.

441. This species is generally propagated by cuttings of the young wood (see Fig. 76), which are rooted in the nursery-ground with extremely little attention; and after remaining one year in the cutting state in the nursery, they are fit for transplanting out into the forest-ground.

442. In order to grow this species profitably, they should be planted in a good strong loam, having rather a tendency to dampness, though I have seen trees of a very large size growing upon a poor and sandy soil, situated

upon a sloping bank, where water percolated freely down the slope; but none of the poplars will succeed profitably upon a dry, thin, high-lying soil. The *Populus nigra* is well suited as a forest tree either in a mass or mixed among spruce firs in any low-lying part of forest ground; and as a coppice-wood tree few are more profitable. When cut down, the stools in a few years send up shoots of great size, which may be used for basket-rods, flower-sticks, crate-stuff, or poles of any description; but when cut young, they do not last long.

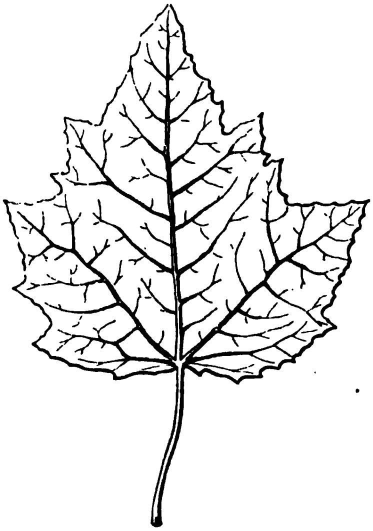
FIG. 76.



443. The POPULUS ALBA, or *Abele-tree*, is another of the family which, under favourable circumstances, attains large dimensions. Its specific character is thus given by Smith:—Leaves lobed and toothed; somewhat heart-shaped at the base; snow-white, and densely downy beneath. Catkins of the female plant ovate. Stigmas, 4.

444. This is a tree of a beautiful upright habit, and upon a lawn or park it makes a very fine contrast by its white, waving, downy leaves and silvery branches, glittering among others of a darker colour; like the *P. nigra*, it delights in a sheltered situation upon a dampish loamy soil. The wood of this species is very light and spongy, but is as durable as the former when cut up. I have cut up a considerable quantity of it for planking which is used for flooring, cart and waggon bottoms, &c., and it sells for these purposes readily; in fact, I have never been able to supply the demand which I have for this sort of wood, which is much sought after for cart-bottoms, and all such purposes; and, considering its rapid growth, it is a tree far too little planted in our home forests. I have planted it extensively in damp hollow parts, and in situations such as I used to plant with spruce firs formerly; and I find that, next to the black poplar, it is the most rapid-growing of the genus, and well worthy of extensive culture for country purposes.

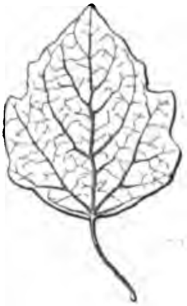
FIG. 77.



445. The leaves of this species are upon young plants almost *palmate*, and larger than those taken from an older tree. (See Fig. 77, which shows them as taken from a coppice of the second year's growth.) In the young state the leaves are covered with a white

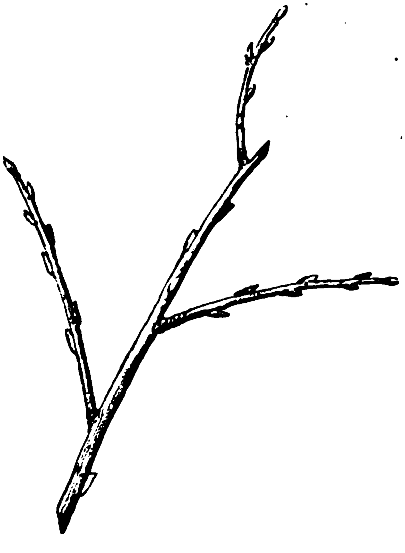
down beneath, and on the upper surface but slightly. Upon plants a few years old the leaves are much smaller, and also dark-green, and smooth on the upper surface, and not palmate, but merely lobed, and somewhat toothed. (See Fig. 78.)

FIG. 78.



446. The young branches are also thickly covered with down, and are of a more spreading and ramifying habit than those of the last-mentioned sort (see Fig. 79), and also more slender and tough. The young plants are furnished by cuttings, layers, and suckers, which rise freely from the roots wherever they are growing; and if put into the nursery-ground in the spring, they will be ready for transplanting out into the forest-ground in the autumn or spring following.

FIG. 79.



447. This species, as well as the *P. nigra*, thrives best in a loamy dampish soil; but I have frequently seen good large trees cut down upon a rather dry and poor soil; and in any moderately sheltered situation, where it may have the advantage of a supply of fresh running water, as upon the banks of a stream, it forms a very profitable forest-tree, and might be turned to advantage in many places where the elm has been planted and is not succeeding well. I could point out many plantations upon estates where the ash, elm, and firs have been planted, which, on account of the soil and other circumstances being unfavourable to them, are at present in a very unhealthy and unproductive state, upon which, had the Abele poplar been planted, a tenfold return would have been realised, independent of proving a most pleasing object to look upon.

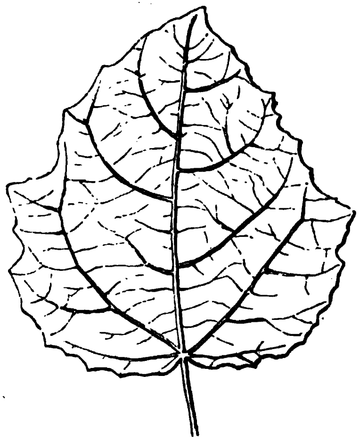
448. This is a most excellent tree for coppice-wood, and produces a crop very quickly; and the young shoots, when arrived at from ten to twelve years old, are extremely useful for many country purposes, such as paling-rails, posts, gates, &c. In 1843 I cut down a coppice of this description upon the estate of Arniston, and in the year 1848 the shoots had risen to the height of fifteen feet, and stout in proportion; thus showing the fast-growing nature of the tree when treated as a coppice.

449. The Gray Poplar (*P. canescens*) very much resembles the last-mentioned species, but is easily distinguished from it by its greater propensity to send up suckers, and that at a great distance from the tree. Its specific character is thus given by Smith: Leaves roundish, deeply waved, toothed; hoary and downy beneath. Catkins of the female plant cylindrical; stigmas 8. It is essentially distinguished from *P. alba*, as Mr Crow first discovered, by the stigmas, which are 8, spreading in two opposite directions. The bracteas of the fertile flowers are, also, more deeply and regularly cut. The branches are more upright and compact. The leaves are rounder, more conspicuously 3-ribbed, and less deeply or acutely lobed; not folded in the bud, and without gum. They are downy beneath; but the down is chiefly greyish, and not so white or cottony as in *P. alba;* in some instances the leaves are glabrous.

450. In favourable situations it grows as rapidly and to as great a size as the *P. alba*, but has its branches thrown out more uprightly than it; and, in my opinion, it forms a very ornamental tree in a low-lying situation upon a soil adapted to its nature. Upon the home-parks about Arniston there are several trees of this species of a considerable size, upon a rather dry soil, and rather an exposed situation. It is a very hardy tree, and attains a timber size upon a greater variety of soils and situations than any other of the poplar tribe. But, notwithstanding, its favourite locality is upon a good loam, near to a supply of running water. In such a situation it forms a very large spreading-topped tree, frequently rising to eighty and ninety feet high.

451. The quality of the wood very much resembles that of the last-mentioned species, and is sought after for the same purpose. I have this season cut up a considerable quantity of it into planks for millwright purposes, it being considered very durable for water-wheels; and, as a timber tree, it pays the planter well—I having got 2s. 6d. per foot for the squared timber, which is a higher price than I can get for larch-wood. This arises from the scarceness of the poplar tribe as a timber tree; and this is to be regretted, as I am aware that, were it more cultivated, it would be much sought after, and make a very profitable return.

FIG. 80.



452. Its leaves are easily distinguished from the *P. alba* by their lobes not being so deep, and the down being somewhat grey upon the under side of the leaf. (See Fig. 80.)

453. This species also makes an excellent coppice, and is very productive in young shoots, which rise up freely in a very indifferent soil, and might be made very profitable if cultivated to a good extent near any market for hoop-wood, for which it answers well when young. Coppice of this description is also much sought after for crates and other coarse basket manufacture; and as a coppice it is very easily kept up, on account of the great tendency the tree has to throw up suckers all over the ground upon which it grows.

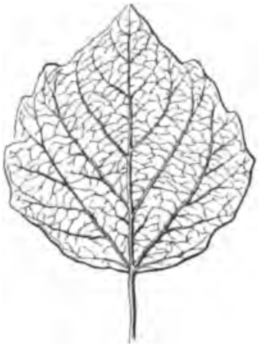
454. It is propagated in the same manner as the last-mentioned sort, but very seldom from cuttings; the suckers in all cases making the preferable trees: therefore these are almost in all cases preferred for a supply of young trees. And when they are lifted from the roots of the parent plant, and put into rows in the nursery ground for one year, they will then be ready for transplanting out into the forest. As, however, a supply of plants from this source cannot always be had, nurserymen generally propagate them from layers upon stocks cultivated for the purpose in their grounds, and in the same way as they do the English elm.

455. The Aspen, or *P. tremula*, is a very interesting species of this family, on account of its leaves being put into motion by the slightest breeze; and, indeed, few objects are more attractive in nature than the motion of the trembling poplar in a calm evening. Upon the farm I now occupy, there stand several groups of fine aspen poplars, from forty to fifty feet high, with their clean grey stems and rugged horizontal branches stationary as the earth upon which they stand; with leaves all in motion, like an agitated sky, without a breeze of wind below. I have not indeed, hitherto, entered into feelings of a poetical nature in describing the character of the different trees; but when I now come to speak of the character of the aspen, I am, as it were, involuntarily led to say, that as regards my own private feelings, it is the only tree that recalls to my mind "days bygone," and makes me forget that I am writing a practical work. With the aspen there are associated scenes of early life; and at the present moment, although the evening is so still that the sound of the Spey a full mile off is easily heard, the leaves cannot remain quiet; and now and again, as the air rises into the most gentle breeze, and almost brings with it the sound of the very minnows' flip upon the surface of the water in the far-off pool, the leaves of the aspen vibrate to the sound, and their rustling falls upon the ear sweeter than any music.

456. The specific character of the aspen, according to Smith, is:—Young branchlets hairy. Leaves having compressed footstalks, and disks that are roundish-ovate, or nearly orbicular; toothed in a repand manner, downy when young, afterwards glabrous on both surfaces. Stigmas 4, erect, eared at the base.

457. Although this is a very interesting species of the poplar, and is worthy of a place in a well-chosen part upon the park, yet as a timber tree it is of a secondary rank, and does not produce timber of so good a quality as the others already described. The wood, when cut up, is in all cases short-grained, and very easily broken when applied to any useful country purpose.

FIG. 81.



458. The leaves very much resemble those of the grey poplar; but they are easily distinguished from them by being more round, and also smooth on both sides, after the month of June. (See Fig. 81.)

459. This tree is propagated in the same manner as the grey poplar, principally from suckers, and sometimes from layers in the nurseries; and from its tendency to throw up suckers, it also makes a profitable coppice-wood.

460. The Lombardy poplar (*P. fastigiata*), if not a tree suitable for the forest as a timber bearing one, is at least excellently adapted to stand as an ornamental one on a park among other sorts, as its tall and upright form has an imposing effect among trees of a lower and spreading habit. I often admire the effect of this tree on English home parks, especially where it stands upon a level part, with trees of a low and spreading character behind it. On such situations its tall columnar outline contrasts admirably with that of the oak, the elm, and many others.

461. The specific character of this tree is: Petiole compressed. Disk of leaf deltoid, wider than long, crenulated in the whole of the edge, even the base; glabrous upon both surfaces.

462. This tree is said to be indigenous to Italy, and in that country to grow to the height of one hundred and fifty feet on favourable localities; and it seems to have been introduced into this country in 1758.

463. It is readily distinguished from all the other poplars, and indeed from all other deciduous trees we are acquainted with in this country, by its branches growing upwards nearly in a line with the stem itself, and from its having, properly speaking, no horizontal ones at any stage of its growth. In this respect its habit very much resembles that of the Irish yew.

464. From the stem of this tree being generally deeply furrowed, and seldom attaining large diameter, it is not valuable as timber, but chiefly prized for its rapid growth and ornamental effect. I could point out many trees of this species, not over fifty years planted, nearly one hundred feet high.

465. It requires a strong loamy soil to enable it to grow so rapidly as it is capable of doing, and at the same time, a low-lying and naturally sheltered situation; without these it grows comparatively slowly, and becomes a tall, dense, branched bush.

466. It is generally propagated by cuttings, although sometimes by suckers from old trees.

467. The black Italian poplar (*P. monilifera*), is an American species, which is said to have been introduced into this country in 1772. In Britain it attains very large dimensions, and is well worthy of a place as a timber tree in any part having a soil strong enough for its healthy development. Its specific character in *Arboretum Britannicum* is given thus :—Shoot more or less angular. Branch round. Petiole slender, compressed in the upper part; in some leaves shorter than the disk, in others longer. Disk deltoid, glanded at the base, which is subcordate in some leaves, and very obtusely wedge-shaped in others ; tip acute ; edge serrated all round, except in the central part of the base, and at the acute tip; the teeth have incurved points ; glabrous except in the edge, which, at least when the leaf is growing, is ciliate; edge ultimately, and perhaps early, gristly. Male flowers about thirty in a catkin, upon pedicels. Bractea glabrous. Stamens 16, a little longer than the corolla. Female flowers about forty in a catkin. Stigmas 4, dilated, jagged.

468. The black Italian poplar, on a strong loamy soil, and in rather a well sheltered site, is perhaps the most rapid growing of all our poplars, and attains the largest bulk of available timber; but when planted on an inferior soil, and on a site much exposed to winds, it is inferior to the *P. nigra*, both in regard to the quantity and the quality of its crop. It is only, therefore, as a timber tree, suited to the best districts of the country; and on such we have seen it of extraordinary dimensions, although comparatively young; and its timber is, when the tree is well grown and not too branchy, available for the same purposes as those described in reference to the *P. nigra*.

469. This poplar may be propagated either from the seed, which ripens well in the more fertile parts of the country, or from cuttings.

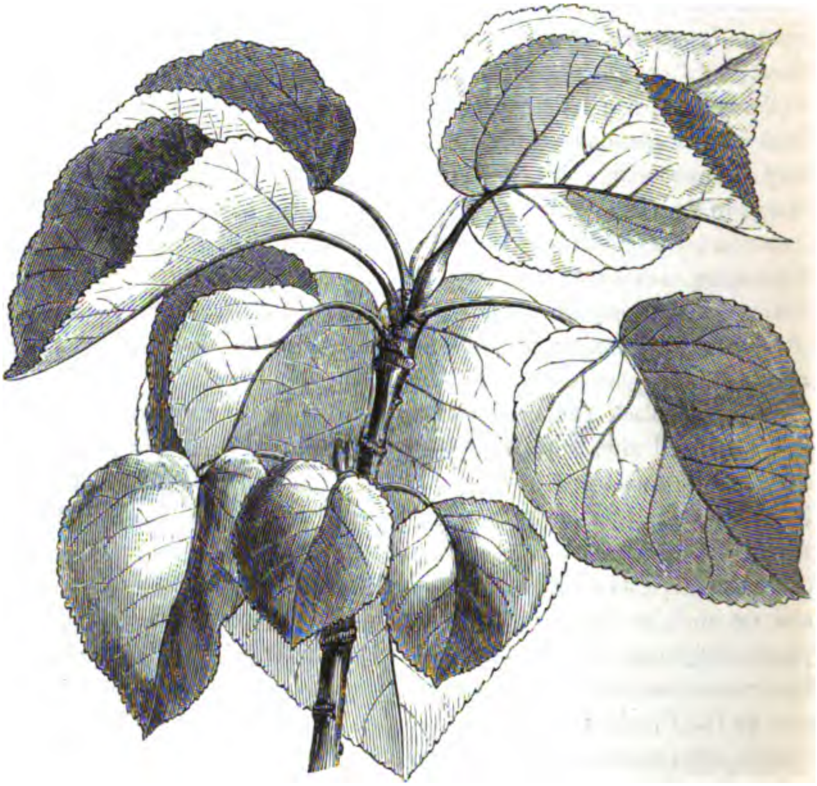
470. The Ontario poplar (*P. candicans*) is another American species said to have been also introduced into Britain in 1772; and as it is of an extremely rapid growth, I think it well to describe it, and to state that in my opinion it is worthy of cultivation as a timber tree, especially on the sides of streams with a shallow soil, on which other sorts of trees would not succeed profitably.

471. The specific character of the Ontario poplar is, as taken from the *Arboretum Britannicum* :—Shoot round. Bud very gummy. Stipules

gummy. Petiole compressed in its upper part, hairy in many instances. Disk of leaf heart-shaped at the base, ovate, acuminate; serrated with blunt unequal teeth; 3-nerved; deep green on the upper surface, whitish on the under one, on which the veins appear reticulate. Inflorescence similar to that of *P. balsamifera,* and the disk of the leaf thrice as large as in that species. (Mich.)

472. This species is easily distinguished from all the other sorts of the same family by its very large heart-shaped leaves (see Fig. 82), some of which have measured ten inches from base to apex: they are generally from six to eight inches in length, and of a beautiful deep green on the upper surface. It may be also easily distinguished from any of the other poplars by its gummy buds, which, especially in the spring, have an agreeable balsamic smell. In this respect it resembles the common balsam poplar; but its leaves are so very much larger that the two are readily distinguished. I planted a few of them while at Arniston, and found that in eight years from planting they stood twenty-five feet in height.

Fig. 82.



473. The species is generally propagated from cuttings, and sometimes from suckers; but to grow it well, it requires to have a plentiful supply of underground moisture.

SECTION IX.—THE WILLOW.

474. The WILLOW (*Salix*) belongs to the natural order SALICACEÆ; or, according to the Linn. system, to that of *Diœcia Diandria;* and the character of the genus is thus given by Don:—Bractea to the flower of each sex entire. Male flower consisting of 1-5 stamens, more in a few species, and of one or more glands inserted contiguously to the stamens. Female flower, consisting of a pistil that is stalked or sessile, or nearly sessile, and one or more glands inserted contiguously to it.

475. There are many species of the willow family, most of them not growing to a size yielding useful timber. We shall therefore at present confine our description to those sorts which are, properly speaking, forest trees. Of these there are three deserving our attention—namely, The *Salix alba*, or Huntingdon Willow; the *Salix Russelliana*, or Bedford willow; and the *Salix fragilis*, or red-wood willow. All these are timber trees of first-rate magnitude, and are well deserving of a place either upon a lawn, or in a forest where profit may be the object.

476. The *Salix alba*, or Huntingdon willow, has its specific character thus described by Smith:—Leaves elliptic-lanceolate, pointed, serrated, silky on both sides; the lowest serratures glandular. Stamens hairy. Germen smooth, almost sessile. Stigmas deeply cloven. Scales notched.

477. The Salix alba, in a situation congenial to its nature, attains the dimensions of a first-rate tree, with an outline as agreeable and as elegant as can be imagined; and it is a tree well worthy of a place in any extensive park or lawn, where the soil is not too thin and dry, nor the situation too exposed. Its growth is very rapid; and it is thus well adapted to plant in any situation upon the park where it may be wished to hide any disagreeable object. Upon the estate of Arniston, I have planted this tree rather extensively, and find it grows well in almost any soil, provided it has a little shelter and moisture. I could point out young trees, only three years planted, standing from twelve to fifteen feet in height; and I believe that, were it introduced extensively into all hollow parts of forest ground, the planter would have a return from his crop which is but seldom realised by the planting of our common hardwood and fir trees in such situations.

478. The wood of all the tree willows is much sought after, and pre-

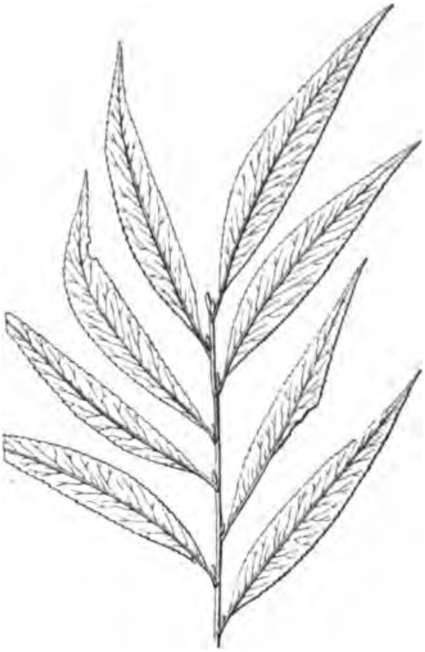
ferred in all cases to that of the poplar. It is reckoned more tough and durable than the latter, and is used for a great variety of country purposes. It makes excellent charcoal for powder manufacturers, and is much sought after for this purpose; but it is not easily procured in sufficient quantity. It is also particularly adapted for lining to stone carts and coal-waggons; for which purposes I have cut up and sold a considerable quantity of it. When struck by a stone, or any other heavy body, the deal produced from the willow is not readily injured nor split as is the case with deals made from the fir and pine trees; and this quality of the wood makes it so valuable for the purpose. In making harrows for agricultural purposes, the wood of the saugh or willow is much used; and as a paling rail it will last much better than the young wood of the Scots pine or spruce fir. Its branches make excellent posts for palings; but they are very apt to grow and set out young shoots. In order to prevent this tendency of the wood, the posts should be made and laid aside to dry for a few weeks before they are used.

479.. In order to have the wood of the willow clean and tall for useful purposes, the trees should be planted in a mass, and drawn up considerably, either among themselves, or planted at twelve feet distance, with a few larch or spruce firs among them as nurses for a time. This is particularly necessary with the Huntingdon willow, which is extremely liable to set off into large branches if left to itself in any open part without confinement; but where planted close together, or mixed with a proportion of firs, it rises to a great height before branching off; and when timeously thinned, excellent timber is produced. As its wood is soft and open in the grain, the willow, and indeed the poplar too, should never be pruned except in the young state. If any branch of considerable size be taken from a full-grown tree, the wound never heals up; the weather takes effect upon the cut part at once, and soon produces rot, rendering the timber near it useless. Therefore, in pruning let them be put into proper shape while young; and in order to do away with pruning altogether, grow them for a few years closely together, which will prevent the side branches spreading to any undue proportion.

480. The leaves of the different sorts of willows have a close resemblance to one another, and, indeed, can only be detected and distinguished by a careful examination of their texture, more than any difference of shape. The Huntingdon willow has the leaves *eliptic-lanceolate*, or between oval and lance-shaped, and *serrated*, the lower serratures bearing small *glands*. Both sides of the leaves are covered with very fine silky hairs, which lie close upon the body of the leaf, giving the leaves a whitish appearance, and causing a beautiful effect when they are slightly moved by the wind.

Fig. 83 is an exact representation of the leaves and young wood, as taken from the plant in the month of August.

FIG. 83.



481. No plant is easier of propagation than the willow; indeed, this characteristic is proverbial among practical men. All that is necessary is to put a cutting of young wood into the soil in the spring, and in the autumn following it will be ready for transplanting out into the forest ground. Indeed, many advise the using of pieces of the older wood for cuttings in propagating the willow; but, for my own part, I have tried both ways, and have always found the cuttings from the last year's wood made the surest and best plants, and ultimately come to be the finest trees. Some foresters also recommend the putting of the cuttings at once into the forest ground without having the plants reared at all in the nursery; but, as regards this plan, there seems to be nothing gained by it in the end. The plants in such a state do not come away so quickly; they are generally two years behind those reared in a nursery, and they are more apt to become branchy. The best method is to raise the cuttings from the young wood, and, when they have stood one year in the nursery rows, have them put out, and they will immediately grow freely, having roots to seek food for themselves at once.

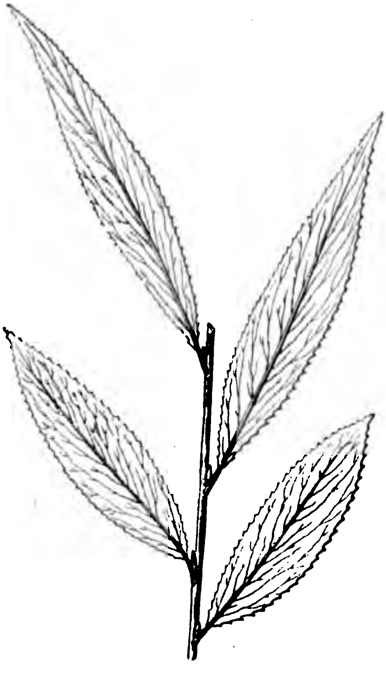
482. I need scarcely say that the willow makes one of the best of all trees for coppice-wood. Every forester or gardener is aware of the nature of a willow bed, and there is scarcely one who has not a bed of this useful plant reared under his own notice for the making of baskets, &c.: for this purpose a great many varieties are in cultivation. In planting willows, whether for large coppice, to be cut over at periods of from three to twelve years, for poles of various sizes, or for cutting over every year for the basket-maker, the ground should be previously well cleaned by the plough, and a crop of some sort taken off it, in order properly to break down the old surface. Where it is intended to cut over the plants every year, the ground must be kept clean always; but where the plants are cut over at

periods beyond two years, the ground may be cleaned at each period of the cuttings only.

483. The BEDFORD WILLLOW (*Salix Russelliana*) is another tree which is well worthy of a place in pleasure-grounds of any extent. Its specific character is thus given by Smith:—Leaves lanceolate, tapering at each end, serrated throughout, very glabrous, foot-stalks glandular or leafy. Ovary tapering, stalked, longer than the bracteas. Style as long as the stigmas.

484. It gives a much better effect upon a lawn than any other of the willow tribe, having a bold outline, and rather a rugged habit, which gives it, when viewed from a distance, the appearance of an ash more than that of a willow. In every other respect, what I have already said regarding the *Salix alba* is equally applicable to the one now under our notice. There is, indeed, so far as I have been able to notice, scarcely any difference in the quality of the two sorts. In similar circumstances they both appear to arrive at the same magnitude of timber, and the wood of the Bedford willow may be used for the same purposes as that of the Huntingdon. When planted upon an exposed situation, the branches of the Bedford willow are very apt to be broken down by high winds; but in other respects, it is, in my opinion, a more hardy tree than the before-mentioned one.

FIG. 84.



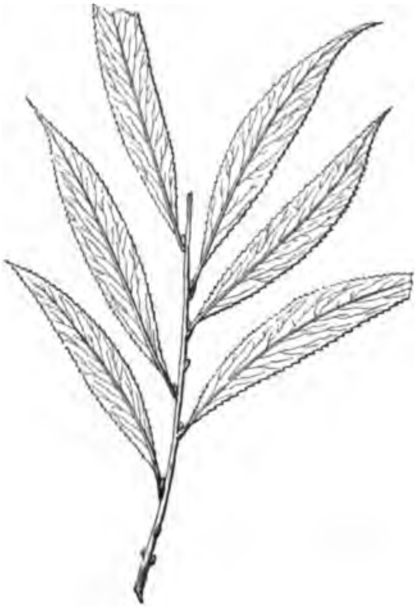
485. As described in the specific character, the leaves of the Bedford are *lanceolate*, tapering at each end, and *serrated* throughout, but without hairs, being smooth on both sides; and by this difference alone this tree may be readily distinguished from the former. The leaves are also larger than those of the Huntingdon. Fig. 84 is a representation of the leaves and young wood, as in the month of August.

486. The RED-WOOD WILLOW (*Salix fragilis*) is a tree more common in many parts of Scotland than either of the two former; and in the north

of Scotland it prevails more than in the southern or midland counties. It is there much prized for the usefulness of its timber; and indeed, in many cold damp parts of the north, it grows to a good timber size, and this too upon a very poor soil. Its specific character is thus stated by Smith:—Leaves ovate-lanceolate, pointed, serrated throughout, very glabrous, foot-stalks glandular. Ovary ovate, abrupt, nearly sessile, glabrous. Bracteas oblong, about equal to the stamens and pistils. Stigmas cloven, longer than the style.

487. The wood of this sort is, in the estimation of most intelligent country carpenters, more durable and tough than that of either of the others; and I have found that I can sell more of it for country purposes than any other wood of the willow kind. Practical builders say, that as a timber for flooring it can scarcely be surpassed, being extremely light, and lasting for a long time. This is also a very fast-growing tree. Upon the estate of Arniston I lately measured a tree of this species, growing upon a good loamy soil, which was nearly seventy feet high, and eight feet in circumference four feet from the ground, though only about thirty-five years old.

Fig. 85.



488. The leaves of this sort very much resemble those of the Huntingdon willow, being slightly downy when young. Fig. 85 is a drawing of the leaves and young wood. It is propagated by cuttings in the same manner as the other varieties, and is, like them, very easy of propagation. There is one particular feature in this tree which I may here notice—viz. its aptitude to become what is termed *stag-headed* when found growing upon a soil not very favourable to its constitution. This is the principal reason that it is so much kept out of lawns and parks, as it thus becomes very unsightly. But as it is a tree bearing as fine a form, when well grown, as the Huntingdon willow, which we often find in extensive parks, it is an unfair estimate of the tree to keep it out of all park-scenery, even when the soil is capable of rearing it properly; and so far as my experience of it goes, I believe that, wherever it is planted upon a

loamy soil, in which it can have a sufficient supply of nourishment, which is generally the case in hollow parts of lawns or home parks, it will not only grow rapidly, but will maintain its health in all its parts as well as any of the two other species. It is only when found growing upon any thin, sandy, or gravelly soil that this tree is certain to become stag-headed. This I have often had occasion to observe, even when the tree was but young; and even in such cases I have also observed that, although the head of the tree did die, the lower part and all the branches, as far as healthy, continued to make wood as if nothing had happened to the head of the tree. In this case, when the tree is pollarded, the effect is by no means bad; it may even, under skilful management, be made an improvement in the scenery. I have also to observe, that where this tree is found as a hedge-row plant, and where the water is too much drained off the ground by any ditch running along the side of the fence, it is sure to become stag-headed at a very early period, in which case the tree is objectionable.

SECTION X.—THE BIRCH.

489. The BIRCH TREE (*Betula*) belongs to the natural order BETULACEÆ, and, according to the Linnæan system, to *Monœcia Polyandria.* The character of the genus is thus stated by Don:—*Barren flowers.* Catkins cylindrical, lax, imbricated all round with ternate concave scales, the middle one largest, ovate. Corolla none. Filaments 10 to 12, shorter than the middle scale, to which they are attached. Anthers roundish, two-lobed. *Fertile flowers.* Catkins similar, but more dense; scales horizontal, peltate, dilated outwards, 3-lobed, 3-flowered. Corolla none. Germen compressed. Styles 2. Stigma simple. Nut oblong, deciduous, winged at each side.

490. There are about twenty species included in this genus, two of which are natives of Britain; the remaining ones partly of North America and partly of the north of Europe and Asia. The two which are natives are the *B. alba* and the *B. nana,* or dwarf birch. I propose here only to refer to the former, as it is a tree of some importance as a timber one; while the latter is a mere bush, seldom attaining a height exceeding three feet.

491. The *Betula alba* is indisputably a native of Britain, and forms, even at the present day, considerable natural forests in the north of Scotland. It is one of the most graceful of all our native trees, and is in consequence generally found in all well-laid-off landscape scenery. As compared with many of our forest trees, it attains at best but very ordinary dimensions as a timber tree; but it is not so much on account of the value set upon its timber that the birch is generally a favourite as on

account of its gracefulness; in which respect no forest tree surpasses it. This is particularly the case with the true weeping variety, which also is found wild in many of the higher districts, both in England and Scotland. A particular recommendation of this variety is, its being of a more rapid growth than the common sort; and on this account the generality of young plants are now raised from the seed of the weeping variety, which is easily known by the drooping tendency of its branches, and also by small white rough spots upon the bark of the young trees. In duration as a tree, the birch is not to be compared with the oak or sycamore; but in a good dry soil suited to its constitution, it lives to a great age. I could point out more than one tree about a hundred years of age, in perfect good health, and likely to live for many years to come. Upon the estate of Arniston there is one particularly good specimen, it being about two feet in diameter at bottom, and fifty feet high; and from its appearance it is likely yet to be much larger. This example shows that, under favourable circumstances, the birch attains dimensions of no mean character, being equal to many trees of the second rank.

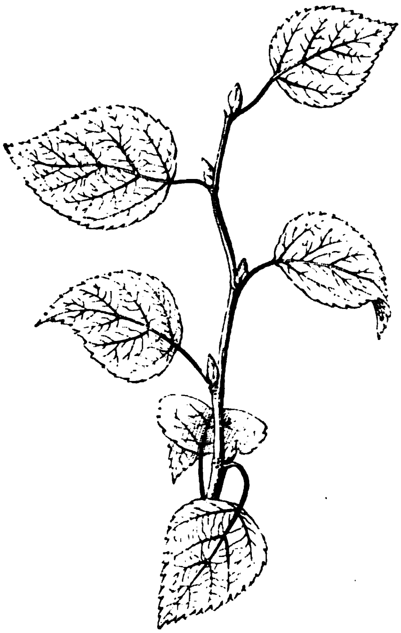
492. In Strathspey there are natural woods of large extent of this tree, which give a very pleasing effect to many of the hill slopes which otherwise would present a very bleak appearance. Any one travelling the great Highland road from Perth to Inverness, will not fail to admire the gracefulness of the birch on the sloping hills situated betwixt Aviemore and Carr Bridge.

493. The wood of the birch is by no means of great durability, in whatever situation it may be placed. I have seen it used in a great variety of ways, both for outside and inside work, and find it, in the open air, as in the case of a paling post, of very inferior durability, not lasting more than three years;—in this respect resembling the beech. Even when used for furniture, it is very soon affected by rot. I have cut up a great deal of it for herring-barrel staves, for which purpose it requires to be from four to six inches in diameter; but since the price of barrel staves has fallen so low, a better return is obtained for the wood by peeling it, and selling it to the powder manufacturers. From them I have got 24s. per ton; and as they take the smallest size of wood as well as the coarsest or largest, this price gives a better return to the proprietor than having all the trouble of cutting the wood into staves, and only getting some 60s. for the thousand feet of these.

494. The foliage of the birch is small; and in spring it has a peculiar sweet smell, particularly after a shower of rain. The leaves are what botanists term *ovate, acute,* and somewhat *deltoid;* unequally *serrated,* and nearly smooth. Fig. 86 is a representation of these. This tree is

raised from seed, which is generally ready for gathering about the first week in October. When gathered, it should be kept in a dry and airy loft or room all the winter, and should be sown in the month of March. In sowing it, care should be taken that the earth upon which it is sown be very finely wrought by the spade and rake. The soil ought to be light, and the surface made as fine as oatmeal, before sowing; and even in the act of covering in the seed, great care is necessary to see that it is not covered too deep; in fact, the slightest covering of earth is sufficient; and this, too, should be of the finest quality. I have frequently seen in nurseries of rather a stiff soil, which could not be easily brought down fine enough to a *mould*, the surface made as smooth as the soil would admit of, and finer soil brought from another part for the purpose of covering in the seed after sowing. Indeed, when the soil cannot be got of a nature fine enough, a very good plan is to sow upon the prepared surface, and give the seed no covering at all, but merely a *clap* with the spade in order to keep the wind from blowing it about. By this plan I have seen an excellent crop of young birch raised.

FIG. 86.



495. About the first week of June the plants will be seen to come up in abundant thickness upon the beds; and as they are easily hurt by weeds, they should receive very particular attention in the way of keeping them clean.

496. One year after the seeds have been sown, the young plants may be lifted and transplanted out into rows in the nursery ground; and when they have stood two years in that state, they may with safety be put out into the forest grounds.

497. The birch is a tree by no means particular as regards soil and situation; in fact, it is one of the most hardy trees we possess, being found to exist as a low tree in the mountainous districts of Scotland, at an elevation of fully three thousand feet above the level of the sea. But notwithstanding this hardihood, it does not attain respectable dimensions unless planted upon a fair soil, and at an elevation something under two thousand feet

above the sea-level. This tree delights naturally in a dry sandy or stony soil, which is generally of the poorest quality; but the largest specimens of it that I have seen grow upon a sandy loam, having a bottom by no means of the driest nature; and as far as I have observed its natural habits, it does not disagree with a little moisture, provided this does not remain stagnated about the roots.

498. As a forest tree, I have found the birch very profitable when mixed among Scots and spruce firs in any high-lying part inclined to moss, and which had been newly dried of moisture. In such places of a new plantation, I generally mix from one-third to one-half of birch-plants among the firs; and when, as is most likely to be the case, a number of the firs do go back, the birch being regularly mixed among them, keeps good to a certainty, and may be relied upon for a cover. In very high situations I make it a practice, in the marking out of new woods, to plant along the most exposed margins birch among firs, where I suspect these latter have a chance not to succeed healthily. By doing so, I am sure to have ultimately something useful upon the soil, when otherwise there might have been partial failure.

499. As a coppice-wood the birch answers well; indeed, in several instances I have found birch coppice more profitable than oak, at the present time when oak-bark sells at £6 per ton. Where there is not much demand for small oak coppice-wood, birch at the same age is decidedly superior in value; seeing that in the case of the birch we can sell both bark and wood, however small, to advantage.

SECTION XI.—THE ALDER.

500. The ALDER (*Alnus*) belongs to the natural order BETULACEÆ; and according to the Linn. system, to *Monœcia Tetrandria.* The character of the genus is thus given by Don:—Barren flowers numerous, aggregate in a loose cylindrical catkin. Calyx a permanent wedge-shaped scale, 3-flowered, with two very minute lateral scales. Corolla composed of three equal florets. Filaments 4, from the tube of the corolla. Anthers of two round lobes. *Fertile flowers* fewer, aggregate, in an oval firm catkin. Calyx a permanent wedge-shaped scale, 2-flowered. Corolla none. Styles two. Stigma simple. Nut ovate, without wings.

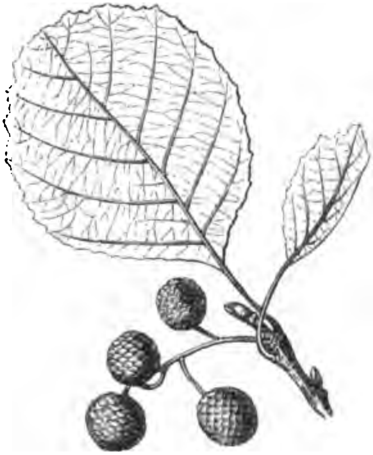
501. There are upwards of twenty species and varieties of this genus, all trees of a comparatively low habit of growth, and natives chiefly of Europe and North America. The only species to which I think it necessary to refer here is the *A. glutinosa,* or common alder, the specific character of which

is thus stated by Smith :—Leaves roundish, wedge-shaped, wavy, serrated, glutinous, rather abrupt; downy at the branching of the veins beneath.

502. This is another of our truly native trees, being found wild along the banks of rivers and marshy parts of our waste lands. In these cases it is seldom found of large dimensions, but generally as a large bush, or at best as a small deformed tree; but where attention has been paid to it, and it has got the same management as other forest-trees, it attains a size by no means despicable, being frequently found, upon a good loamy soil, from forty to fifty feet high, and of proportionable scantling; but in no case will it attain a large size unless it have a considerable degree of moisture for its roots, which is always found by it upon the margins of rivers.

503. The wood of the alder is by no means valuable, nor is it generally applied to many purposes. It is reckoned one of the most lasting of all woods for any underground work, such as piles for bridges; and it is even allowed to stand a long time when covered from the effects of change of dry and moist. So far as my own experience goes, this wood is the one which of all others I incline to reject in the making of any common outdoor work, such as fencing; in fact, I have found posts of this wood useless in less than one year, they being rotten at the part between the earth and air. Still, as a coppice-wood, I have found it very valuable; and that either for the purpose of making charcoal for the proprietor's own use, or for selling for powder-wood, for which purpose it sells at the same rate as the birch,—that is, 24s. per ton for the peeled wood. But unless in districts near to a powder manufactory, I am not of opinion that it could be made profitable, even as a coppice-wood, for any other purpose, unless, indeed, for herring-barrel staves, which do not now pay well.

FIG. 87.



504. Fig. 87 represents the leaves of this tree, and also the catkins containing the seeds. The alder is propagated sometimes by cuttings of the young wood, but principally from the seed. Indeed, although the method of propagating it by cuttings is sometimes resorted to, the plants raised by such means are of little real worth, and never arrive at the character of a tree as those do which are raised from the seed. The young plants ought, therefore, in all cases where healthy young trees are desired, to be raised from the seed.

The seed should be gathered in the month of October, or at least as soon as the scales of the catkins or seed-vessels begin to open a little. When the catkins are gathered, they should be well exposed to the sun upon a sheet for a few days in the open air, when the scales will open widely, and allow the seed to be separated by a slight rubbing and turning with the hands. Many seedsmen, when they gather the seed of the alder, simply lay it past in a dry room, and turn it frequently till the seeds fall out of their own accord. It should be sown in the month of March, and slightly covered. When the plants have stood one year in the seed-bed, they may be planted out into rows in the nursery ground, and there they may be allowed to remain one or two years, according to the strength that the plants may be required to be.

505. The alder is by no means particular as regards quality of soil, but moisture is indispensable. In travelling through the Highlands of Scotland, we often meet with large tracts of this plant, which is always found luxuriating in the swampy low-lying grounds, and on the margins of rivulets; and this at once points out the circumstances favourable to its growth.

506. The alder ought never to be mixed with other trees in a plantation, unless, indeed, we may except the spruce-fir. These may, under peculiar circumstances, be planted together; that is to say, where it may be intended to raise a crop of alder coppice, spruce-firs may be planted as nurses among them, and thinned out for paling, &c., as they advance. Wherever alder has been planted in the form of coppice, it is a tree not easily rooted out of the ground again, and it generally renders the soil upon which it grows more injured than improved; for it is always observable that the alder, if once it gets a footing upon a moderately damp soil, will very soon make it a complete morass. Therefore I am not in favour of planting alder at all, unless it be upon some waste unimprovable piece of land; and perhaps even then, under good management, the birch may be more profitably used.

SECTION XII.—THE CHESTNUT.

507. The CHESTNUT (*Castanea*) belongs to the natural order CORYLACEÆ; and according to the Linn. system, to *Monœcia polyandria.* Don gives the character of the genus:—*Male flowers,* each consisting of a 6-parted calyx, and 10-15 stamens, affixed to its bottom, and extended beyond its mouth. Flowers sessile, and disposed in groups along axillary stalks; each group consists of many flowers, and is involucrated by a bractea and a bracteole. *Female flowers,* consisting each of an ovary taper to the tip, clothed with a calyx, and crowned by its 6-7-8-cleft limb, and bearing as many styles, and having as many cells, with two pendulous ovules in

each. The flowers are disposed 2-3 or more together, within a bell-shaped and externally bristly involucre. Fruit, 2-3 nuts, included in a 4-valved involucre.

508. There is only one species of this tree found really useful in Europe, and it is the only one worthy of notice as a timber-tree in this country—namely, the *C. vesca*, the eatable, sweet, or Spanish chestnut, which is a native of Asia Minor, and has been cultivated in Europe for many centuries.

509. This is a tree which, in a favourable situation, attains large dimensions, frequently surpassing even the oak in this respect; and when grown in an open park or lawn, it is a highly ornamental tree, its general bearing at a distance very much resembling that of the oak; and in the autumn, when its leaves take on a yellow colour, it has a beautiful effect among other trees of darker foliage. Cultivated in these circumstances, also, it lives to a great age. As a timber-tree, however, it falls far short of even what we may consider as our secondary sorts. It does not even attain large dimensions, unless it have the advantage of a good loamy soil, and a good situation, and is therefore not adapted for generally planting out as a forest-tree in any exposed situation upon an indifferent soil.

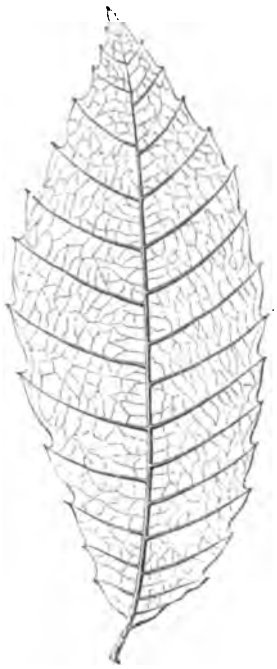
510. When young, it grows very rapidly, and very soon attains a large size; but I have seldom seen one which had arrived at the age of fifty or sixty years, which was not *ring shaken* in the heart-wood, and, in fact, almost useless for any particular purpose. Knowing this to be the case with the tree in most situations, I am not inclined to plant it much myself, and of course cannot conscientiously recommend its cultivation to others—at least with the view of raising useful timber from it. The wood of the sweet chestnut is, however, generally found good for many purposes up to the age of fifty years; and as a secondary tree, or one which is grown for a time among others which may be meant to stand as a permanent crop upon the ground, it is very well adapted. But even allowing that this tree would do well as a secondary, or nurse, in many situations, I have, for my own part, never found an instance in which its place could not be more profitably filled by the larch, ash, or sycamore; and I never do introduce the sweet chestnut into any forest-ground of which I have the management. In all cases where it might be planted as a secondary tree, and where it might be cut down in order to give room to others by the time it was from thirty to forty years old, I have found that the larch or ash is far more profitable; while, as a tree for a permanent crop, its place is infinitely better filled by the oak, larch, or ash. The wood of the sweet chestnut is undoubtedly very durable. For posts and gate-posts I have found it answer most excellently; and even for cart-trams it answers well when from thirty to forty years old, and for many other purposes besides. I have cut a considerable quantity of this wood for herring-barrel staves, for which purpose it is well adapted; but at present it would pay a proprietor very poorly

indeed to grow this sort of wood for that purpose. It is, however, excellently adapted for coppice-wood; and in all districts where there may be a demand for hoop-wood of various sizes, or for hop-poles, the sweet chestnut would pay well in the form of coppice. It readily throws up a succession of young shoots from the stoles when cut over, which grow very rapidly for the first eight or ten years, frequently at the end of that period producing shoots from three to four inches in diameter, and from fifteen to twenty feet high; and these, too, very numerous round the stoles.

511. The foliage of the sweet chestnut is full upon the young wood, and has a very fine effect in the early part of summer, as well as in the autumn, when it begins to take on the yellow tinge. The leaves are what is termed by botanists oblong-lanceolate, acuminate, and mucronately serrated. (See Fig. 88.)

512. The sweet chestnut is propagated in exactly the same manner as the oak; and what has been said relative to the oak is equally applicable to the sweet chestnut; but with this exception, that the chestnut is generally, when young, of a more rapid growth than the oak, and is therefore ready for transplanting into the forest ground after having been two years in the nursery rows. In all cases where it is desired that they should grow to good trees, they ought to have a good loamy soil, upon a dry and rather sheltered situation.

FIG. 88.



SECTION XIII.—THE HORSE-CHESTNUT.

513. The HORSE-CHESTNUT (*Æsculus*) belongs to the natural order ÆSCULACEÆ, and according to the Linn. system, to *Heptandria Monogynia.* The character of the genus is thus given by Don:—Calyx campanulate. Petals 4, or 5, expanded, with an ovate border. Stamens with the filaments recurved inwardly. Capsules echinated. Leaflets sessile, or almost sessile.

514. There seems to be only one species of this tree that grows to a large timber size—namely, the *Æsculus Hippocastanum,* although there are several sorts of it of a comparatively low and bushy habit. I shall, therefore, confine my description of the genus to this one alone. It is a tree of great beauty, and may properly be said to be the only flowering

tree we have upon our lawns. It is of very rapid growth, and in a few years attains a considerable size. But in order to attain respectable dimensions, and to have the appearance which its massy foliage and heavy limbs are calculated to produce, it requires to be grown upon a good rich loamy soil, and in rather a sheltered situation; at least, it must be in a situation where it is not apt to be exposed to severe storms of wind. It is by no means a delicate tree, although a native of Asia: it is, in fact, a hardy tree, so far as regards the degree of cold which it can bear; but, from the short-grained texture of the wood, which is very brittle, it is not at all adapted to grow in an exposed situation.

515. The wood of the horse-chestnut is of a soft nature and white colour, and by no means calculated for general use. On this account its general cultivation as a forest tree cannot be recommended; but as an ornamental tree, very few can surpass it.

516. The leaves of this tree have a very fine massive effect when the tree is placed among others of a more light and airy character; and as they appear pretty early in the season, accompanied by the rich pink-white flowers, the tree is upon that account more worthy of a place upon the lawn. The naked tree is in itself of a stiff character, the young shoots being large, and not numerous. See Fig. 89, which is a representation of the young shoots, and Fig. 90, representing the form of the leaves upon a reduced scale.

FIG. 89.

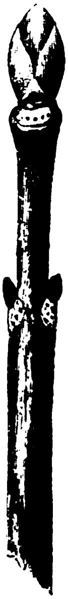
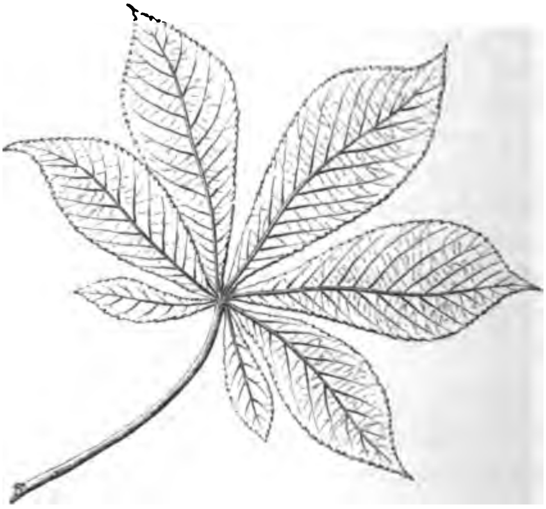


FIG. 90.



517. This tree is propagated from the seed, which is termed a nut. These are generally ripe in the month of October, and they should be sown immediately when gathered, as they are extremely apt to lose their vegetative powers if kept long. They may be sown either in beds or in rows, in the same manner as has already been recommended for the oak-seed. The young plants make vigorous shoots the very first year, and are fit for being transplanted out into nursery rows when one year old; in which they may remain for one or two years, according as the plants may be wished to be small or large.

SECTION XIV.—THE LIME TREE.

518. The LIME TREE (*Tilia*) belongs to the natural order TILIACEÆ; and according to the Linn. system, to *Polyandria Monogynia*. The character of the genus is thus given by Don:—Calyx 5-parted. Petals 5. Stamens numerous, free, or somewhat polyadelphous. Ovary globose, villous, 1-styled, 5-celled; cells two-ovuled. Nut coriaceous, 1-celled, 1-2 seeded, from abortion.

519. There are several species and varieties of this genus, all natives of Europe and America; but the only one I consider worthy of recommendation, both as a timber and an ornamental tree, is the *Tilia Europæa*, or common lime tree of Europe. Its specific character is:—Petals without scales. Leaves cordate, acuminated, serrated, smooth, except a tuft of hair at the origin of the veins beneath, twice the length of the petioles. Cymes many-flowered. Fruit coriaceous, downy. Don.

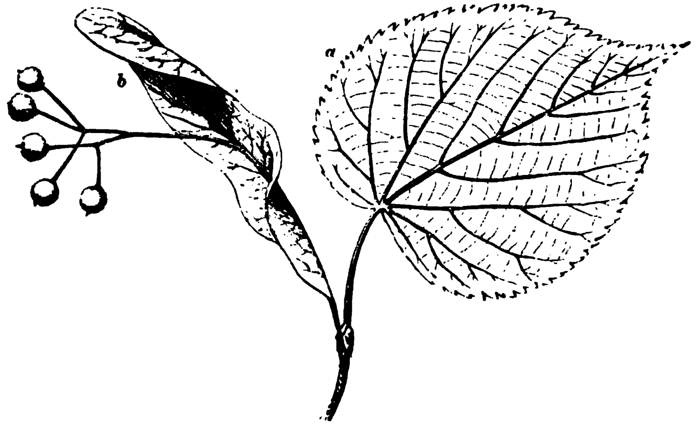
520. This is one of the most beautiful and interesting of our ornamental trees in the month of July. Many object to it as being of a stiff and formal outline, and a clumsy habit, and as not presenting that shade and light which are required for picturesque scenery. This is no doubt true; but in certain situations, such as along the sides of walks or avenues, it is one of the most desirable of trees. Even when standing singly, freely exposed to the open air, and when contrasted among other trees, it forms a beautiful object when in full flower; indeed, as an ornamental tree, in almost any situation, few will object to its presence. This is a tree which, under favourable circumstances, attains very large dimensions, and lives to a great age. There are upon the Arniston grounds many fine lime trees; but there is one in particular, about ninety feet high, and four feet in diameter four feet from the ground, and, I believe, about two hundred years old. It is in the end of July, and for some time in August, a perfect mass of flower, the sweet perfume of which is surpassingly agreeable for a

good way off. In the sunshine, thousands of bees may be heard humming and busy gathering their store; and from the flowers of this tree it is said the best honey is produced.

521. The wood of this tree is white in colour, and of a peculiarly close and soft nature, being particularly well adapted for all turnery work. It is much sought after for boards upon which to cut leather. It is also used in the making of musical instruments, as in the case of sounding boards for pianofortes. In Russia and Sweden, the inner bark of the lime tree is manufactured into the bass-matts which are so much used in this country for various purposes. It is also used in making charcoal for gunpowder.

522. The leaves of this tree are of a fine light green, and are described by botanists as smooth, *cordate*, *acuminated*, and *serrated*. (See Fig. 91, *a*.)

Fig. 91.



There is a peculiar appendage attached to the peduncle of each of the cymes of flowers of the lime tree, termed the floral leaf, out of which the flowers protrude, as it were. (See Fig. 91 *b*.)

523. The seed very seldom ripens in this country, that only taking place in very fine seasons; therefore the tree is propagated by layers, by which mode it is very readily multiplied. It being a soft-wooded plant, it easily strikes root by layering. When the layers are one year old, they may with all safety be removed from the parent stock and transplanted into the nursery rows, where they may remain for one, two, or even three years, according as the plants may be wished to be large or small.

The lime tree is one which I have found very easy to transplant with safety at a considerable age and size. Hence it is very useful in filling up gaps, or for making groups to have immediate effect upon a lawn. In order to arrive at perfection in point of magnitude, it requires to be planted upon a good, rich, and rather dampish loam, and in a pretty sheltered situation; therefore it is by no means adapted as a generally useful forest tree for our woods.

SECTION XV.—THE WALNUT TREE.

524. The Walnut (*Juglans*) belongs to the natural order JUGLANDACEÆ; and according to the Linn. system, to *Monœcia Polyandria*. The character of the genus is:—Flowers unisexual, monœcious. *Male flowers* in cylindrical, drooping, solitary catkins. Calyx of 5-6 scales. Stamens 18-36. *Female flowers* solitary, or a few in a group, terminal upon a shoot developed in the same year. Calyx ovate, including and adhering to the ovary. Petals four. Stigmas 2-3, fleshy. Fruit a drupe; covering of the nut a fleshy husk of one piece that bursts irregularly. Nut woody, of two valves. (Don.)

525. There are several species and varieties of this tree; but the only one I shall refer to here is the common walnut (*Juglans regia*), which is said to be a native of Persia, and to have been introduced into England about 1562. This species is readily distinguished from the others by its leaves, which are oval, glabrous, and obscurely serrated, and the leaflets on one leaf from five to nine. See fig. 92.

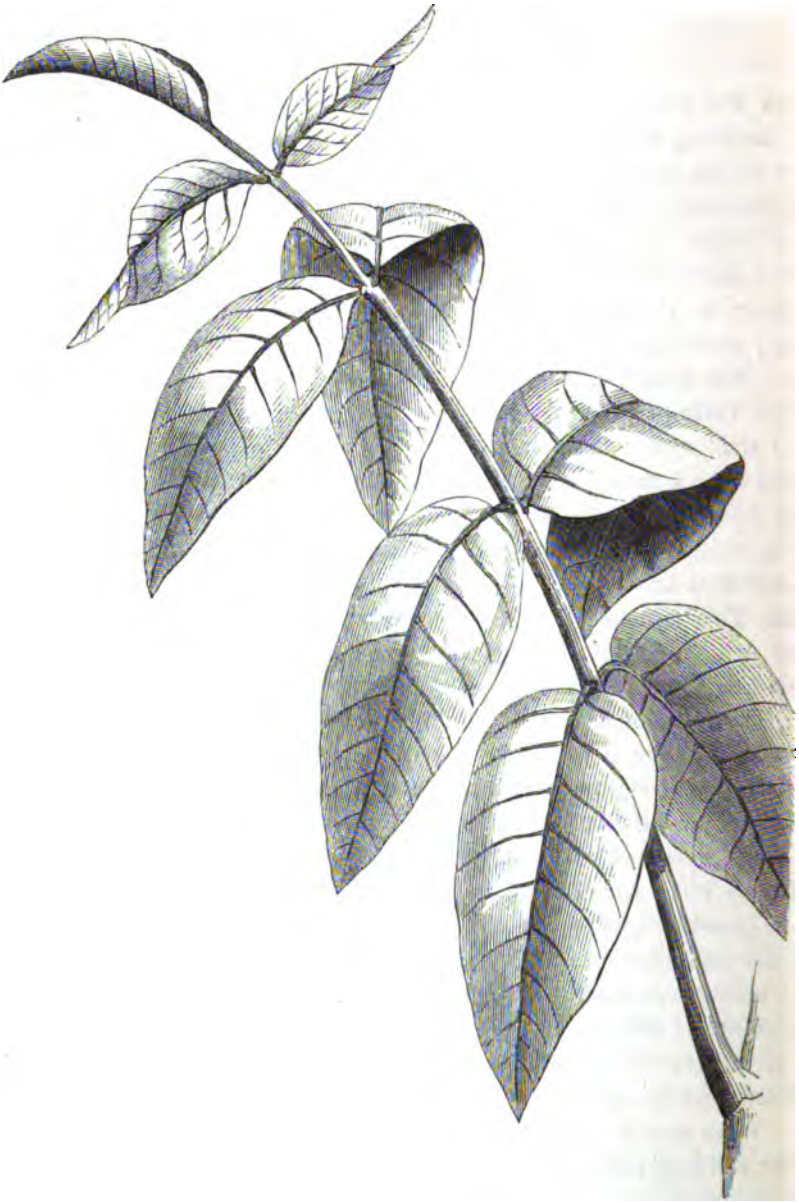
526. This tree has hitherto been cultivated chiefly for its fruit, but I am of opinion that it might be turned to good account for its timber also. When the tree is young, its timber is soft and white, and worthless as compared with that of most other young trees; but after it has attained from fifty to sixty years, it begins to become hard and solid in the interior of the tree; till about eighty years it becomes of a very solid texture, of a dark brown colour, and very prettily veined. It is very much sought after for furniture purposes, and I have sold some trees of it for this at 5s. 6d. per foot. It is also much sought after for gun stocks, and in 1853 there was some talk of growing it in the Government forests for this purpose; but whether this has been gone into or not I cannot tell. I should say, however, that there are large enough districts of good land in these forests for the profitable growth of this tree for gun stocks.

527. To grow this tree to a really valuable size, it requires to be planted in a deep and strong loamy soil, rather light than heavy, and by all means dry. When grown upon a soil wet in the bottom, it becomes shakey in its timber at a very early stage, and consequently never becomes large or valuable for any purpose; but when grown on a deep dry loam, it becomes a handsome tree, and of sound timber.

528. This tree is always grown from the nuts, which are generally ripe about the first of October. They may be sown either in rows or in beds,

and as they are very apt to lose their vitality if long kept, they should be

FIG. 92.



sown as soon as possible after they come to hand, whether they may be imported or grown in the country.

529. As the plants make strong tap roots the first year, they should be lifted when only one year old, and planted out into lines, which will cause them to become more fibrous and safe to plant out into their permanent sites.

SECTION XVI.—THE TULIP TREE.

530. The tulip tree (*Liriodendron*) belongs to the natural order MAGNOLIACEÆ; and according to the Linn. system, to *Polyandria Polygynia.* The character of the genus is thus given by Don:—Carpels 1-2 seeded, disposed in spikes, indehiscent, deciduous, drawn out into a wing at the apex. Calyx of 3 deciduous sepals. Corolla of six petals, conniving into a bell-shaped flower.

531. There is only one distinct species of this tree, the *L. Tulipifera,* which is a native of North America, and is a free growing tree, attaining a large size even in this country, and especially in the southern and midland counties of England.

532. This tree is easily known by its leaves, which are quite characteristic and unlike those of almost any other tree—very much resembling a riding saddle, see fig. 93. They are thus described by botanists: *smooth, truncate* at the top, and *four lobed.*

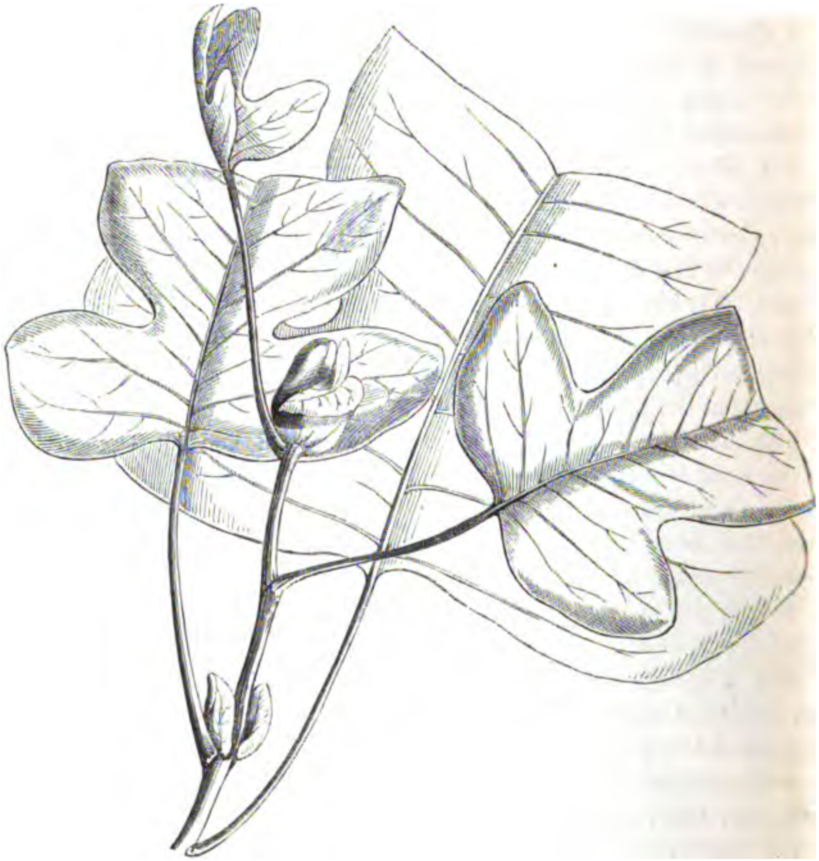
533. The tree is cultivated chiefly for ornament, and not for its timber, as its wood is soft, yellow in the heart, and comparatively worthless so far as I am acquainted with it. There are few trees, however, more ornamental than it is, as its very luxuriant foliage, together with its numerous yellow, or rather greenish-yellow tulip-shaped flowers, give a very fine effect, which is heightened by the unusual contrast the whole plant makes when it flowers, as compared with any other tree in its neighbourhood.

534. Although this tree is, generally speaking, hardy enough to stand the climate of this country on favourable parts as far north as the southern slope of the Grampians, still it is comparatively tender, and succeeds only in very sheltered situations, and on a deep dry loamy soil. I have seen some very fair specimens in the midland counties of Scotland, and these stood upon lawns where there was a considerable degree of shelter from the presence of other larger and branchy trees, and at the same time where they had enough of light and air to ripen their wood.

535. Although, generally speaking, it grows well in the more favourable parts of this country, and flowers profusely, it ripens its seeds only in favourable seasons, even in England. The supply of seed for the raising of a stock of plants is therefore got from America. The seeds should be sown as soon as they are received, which may generally be in the autumn. If this is attended to, the plants will come up in the following spring; but if they

should not be sown till spring, they will, in all probability, be dormant till the next spring. As the young plants are not furnished with fibrous roots, nurserymen are in the habit of sowing the seeds in pots, and after they have stood one year in them, they transplant them into lines in the open ground; which mode tends greatly to encourage fibrous roots, and therefore to secure success after transplanting. From this disposition of the plant to run to tap root and not to fibrous roots, the plants should never be allowed to remain longer in the nursery than two years from the time of their coming above ground, as if they should be kept longer they will not transplant so safely afterwards.

FIG. 93.



SECTION XVII.—THE HORNBEAM.

536. The Hornbeam (CARPINUS) belongs to the natural order of *Corylaceæ*, and according to the Linn. system, to *Monœcia Polyandria.* The character of the genus is thus stated by Don :—*Male flowers*—Catkin lateral, sessile, cylindrical, Bracteas imbricate. Flowers consisting of 12 or more stamens inserted at the base of a bractea. Anthers bearded at the tip, 1-celled. *Female flowers* in lax terminal catkins. Bracteas of two kinds, outer and inner; outer bracteas entire, soon falling off; inner bracteas in pairs, each 3-lobed. Calyx clothing the ovary to near its tip, and adhering to it; toothed at the tip. Style very short. Stigmas 2, long, thread-shaped. Fruit not attended by the involucre; ovate, compressed, ribbed, clothed, except at the base, and tipped with the adnate calyx; woody; including one seed.

537. There are several species and varieties of hornbeam introduced into this country, to one of which only I shall refer, namely, the *C. Betulus*, as it is a European species, very hardy, and attains, under favourable circumstances, very considerable magnitude of timber. The specific character of this tree, according to Smith, is:—Bracteas of the fruit flat, oblong, serrated, with two lateral lobes.

538. It is a singular fact in the history of the arboriculture of this country, that although the hornbeam, when grown on a good loamy soil, often attains a diameter of stem from two to three feet, or even more, with a height of some 60 or 70 feet; and although under such circumstances it is a very ornamental and dense-headed spreading tree, it has not been much cultivated, but rather neglected and reduced to the position of a mere hedge plant. This may have arisen from the great tendency that the tree has to become branchy and short of stem, and thus not much worth as timber; and hence its general fitness for hedging purposes. It is, notwithstanding, a tree capable of being cultivated to very considerable timber size, as I have seen some excellent specimens of it when grown in a plantation among other trees, where it had its tendency to throw out branches checked by standing among them. In fact, this tree is so seldom seen of timber size that I have known many practical foresters of long experience who did not know it when they had one pointed out to them, and who conceived it to be a species of beech.

539. It certainly does pretty much resemble the common beech, but it is easily distinguished from it by the *feather-nerved* and *plaited* appearance of the leaves (see Fig. 94), as well as by the appearance of the seed or nuts, which have a flat, leafy, three-lobed appendage (see Fig. 95).

540. The plant is chiefly reared for hedging purposes; and as it stands pruning well, it answers for this purpose admirably.

541. The seed does not generally ripen in Scotland, but in England it does readily. It should be sown when gathered, in the month of October, as the greater part of it generally requires to lie one year in the ground before vegetating. The plants should be planted out into lines when one year old, and allowed to stand for two years before being put out to their permanent sites.

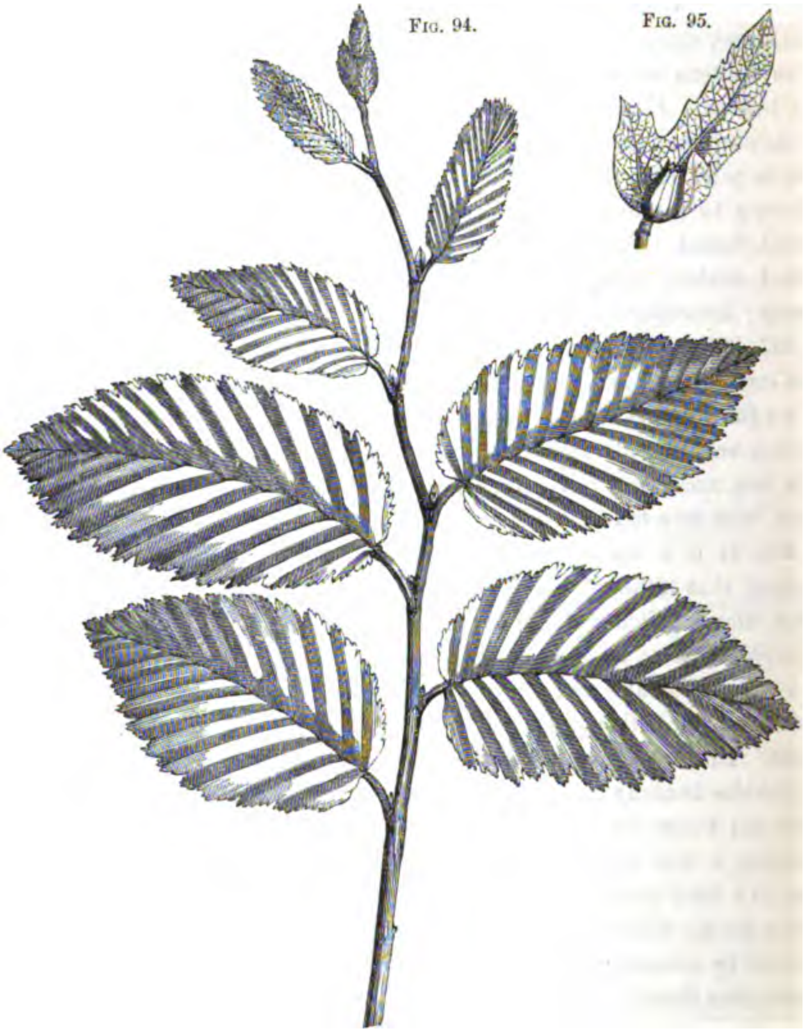


FIG. 94.

FIG. 95.

SECTION XVIII.—THE CHERRY.

542. The Cherry (*Cerasus*) belongs to the natural order ROSACEÆ, and; according to the Linn. system, to *Icosandria monogynia*, and its generic character, according to Don, is :—Drupe globose, or umbilicate, at the base; fleshy, quite glabrous, destitute of bloom, containing a smooth, rather globose compressed stone.

543. As almost all the species of this genus are cultivated chiefly either for their fruit, or for ornamental purposes, and as only one of them is considered worthy of being planted as a timber tree, namely, the *C. Sylvestris*, or the wild black-fruited cherry tree, or gean, I shall not refer to any of them but it.

Its specific character is thus given in the *Arboretum Britannicum* :—Branches vigorous and divaricate; the buds from which the fruits are produced oblong-acute. Flowers in umbel-like groups, sessile, not numerous. Leaves oval-lanceolate, pointed, serrated, somewhat pendent, slightly pubescent on the under side, and furnished with two glands at the base.

544. This tree is very hardy, and often found wild in our woods, and in old hedges, in both of which it has a good effect, in the spring when in flower, in summer when in fruit, and in autumn when the leaves become of a reddish yellow colour. Although attaining pretty large dimensions as a tree, still it is seldom planted exclusively with the view of rearing it for timber, but chiefly for ornament, and partly as a coppice, for which it suits well. I have seen trees of it cut, of forty feet in height, and containing a considerable quantity of timber, which is generally, when of any size, much sought after for cabinetmaking purposes.

545. This tree is propagated from the seed, or stone, so well known to every one that I think no farther description is necessary. They generally ripen in July, and should be sown shortly afterwards, as they are very apt to lose their vitality if long kept.

546. The tree will grow well on any moderately good soil, if dry, and grows rapidly without almost any attention. Most of the other species of cherry which are cultivated in gardens for their fruit, are propagated by ingrafting on young stocks of this tree, raised from seeds.

SECTION XIX.—THE THORN.

547. The Thorn (*Cratægus*) belongs to the natural order ROSACEÆ; and according to the Linn. system, to *Icosandria di-Pentagynia;* and its

generic description, according to Don, is:—"Calyx with an urceolate tube, and a 5-cleft limb. Petals orbicular, spreading. Ovarium 2-5 celled. Styles 2-5, glabrous. Pome fleshy, ovate, closed; the calycine teeth, or the thickened disk, containing a bony putamen."

548. There are upwards of fifty different species and varieties of this genus, chiefly deciduous small trees, or large shrubs, and a few of them only attain the height of thirty feet. The greater number of the species are natives of Europe and N. America, and all are free growers, profuse flowerers, and very ornamental. In a work of this kind, which professes to treat of timber trees only, I shall not refer to any of the members of this family but one, namely, the *C. oxyacantha*, or common hawthorn, which is not only well known and useful for hedging purposes, but also for its ornamental effect, both in summer when in flower, and in autumn and winter when in fruit.

549. It may by many be considered almost superfluous to give the specific character of this plant, as it is so well known that few can possibly mistake it; still I know that foresters, for whom this book is chiefly written, are not generally so well acquainted with the distinctive character of plants, as applied by botanists, as to enable them to state, intelligently and correctly, whether such a plant is one species or another; and it is for this reason that I give the distinctive characters of all those plants I refer to. In fact, it was only the other day that I walked through a shrubbery with a forester, who stands pretty high as a practical man in his own neighbourhood, and who I found could not distinguish betwixt the different species of several of the trees of the common genera, and, indeed, could not distinguish the common thorn plant from another of the same family which bears a close resemblance to it. From this, then, I consider it right to give the distinctive characters of all the plants described.

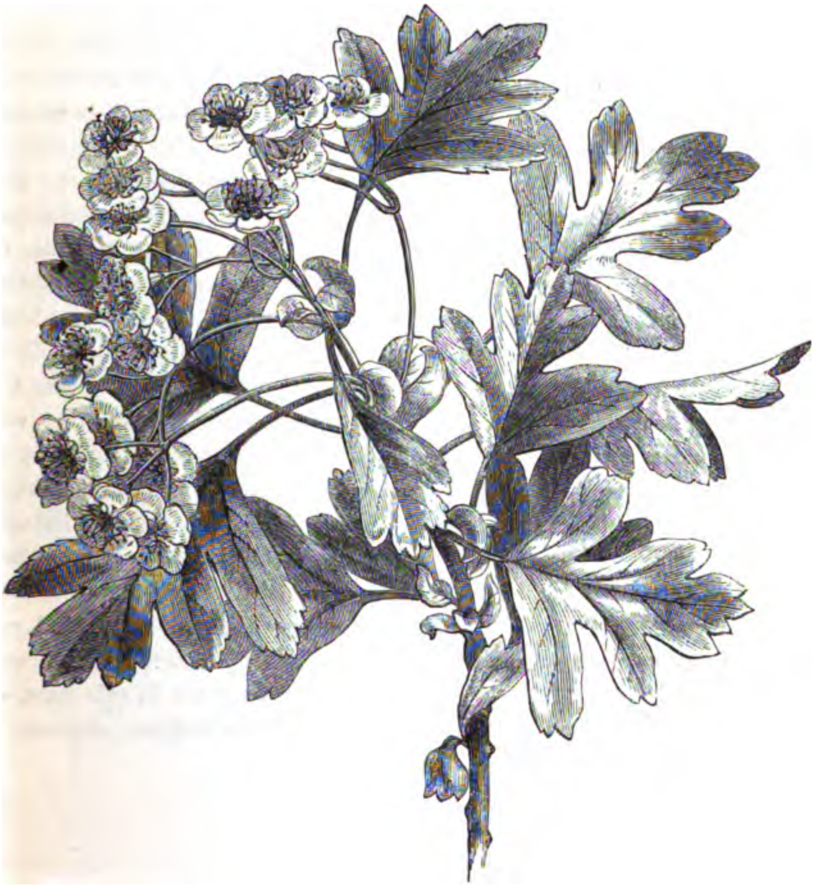
550. The specific character of the *C. oxyacantha* then is:—Leaves obovate-wedge-shaped, nearly entire, or trifid or cut, smooth, rather glossy. (See Fig. 96). Corymbs of several flowers. Sepals without glands, and acute. Styles 1-3.

551. The thorn plant cannot, properly speaking, be considered in the light of a timber tree, although, as I have often seen, it may, by cultivation and attention to judicious pruning, be made to attain very considerable dimensions; still, in this respect, it holds but a low rank, and must be considered merely as an ornamental bush, capable of being trained to the size of a small tree.

552. The great use of the thorn in this country is that of hedging, and for this purpose we have no other plant so suitable; not only from its being adapted to grow in a great variety of soils, but from its firmness of habit, and strength to resist pressure, when properly trained for the purpose.

553. In the wild state, the thorn, when found in a loamy soil with a dry bottom, grows very rapidly when under fifteen years of age, but as it attains the height of from fifteen to twenty feet, it grows more to breadth of top than to height of stem, and assumes the character of a large and spreading bush; and it is in this state that it is so much admired for its profusion of sweet-smelling flowers and bright red fruit.

FIG. 96.



554. As I have already adverted to the raising of hedges from this plant in a former section of this work, I shall not here recapitulate what has there been stated, but proceed to show how the young plants are reared in the nursery. The hawthorn, in seasons favourable for fruit, generally bears a great and abundant supply of seeds, which are generally termed *haws;* these are ordinarily ripe and fit for seed about the beginning of

November. They should, however, never be gathered for seed until they are perfectly ripe, and this state may easily be known by their being of a dark red colour, mealy, and the fleshy fruit separating freely from the stone. If gathered before they are ripe, the cotyledons of the seed are liable to perish from not having been perfected before gathering. The haws should be pulled from the bushes by the hand. When gathered for the purpose of raising plants from them, they should be laid in a heap, in which to rot the pulp, and to separate it from the stones. This is best done by laying them in a ridge form, in the open air, and upon the ground, say twenty-four inches high in the middle, and forty-eight inches broad at bottom, or the ridge may be of smaller dimensions, if a small quantity only are wanted. To prevent the pulpy part of the fruit from heating, and thereby endangering the vitality of the seed, my plan is to mix them with finely riddled soil, say in quantity equal to the bulk of the seed or haws themselves. The whole should be intimately mixed together, so as to hasten the decomposition of the pulp, and should be turned over now and then, say once in the fortnight, so as to turn inwards the portion which lay most exposed to the air, and outward the portion which was innermost. In this rot-heap I allow the haws to lie for fifteen or sixteen months, when the pulp will be perfectly rotted, and the seed ready for sowing. Then, supposing that the haws were gathered and put into a rot-heap in November 1859, they will be ready for sowing in February 1861. They should be sown in beds on a good light mould, properly prepared for the purpose. They should not be sown thickly, but rather thinly, say at the rate of one seed to the square inch, and they should be covered with nearly half-an-inch of earth. They will *braird* the same year, but should not be lifted till they have stood two years in the seed bed. When at this stage, they should be planted out into lines in the nursery, say three inches plant from plant, and the lines twelve inches apart. When they have stood two years in this state, or when they are four years old, they will be quite fit for hedging purposes.

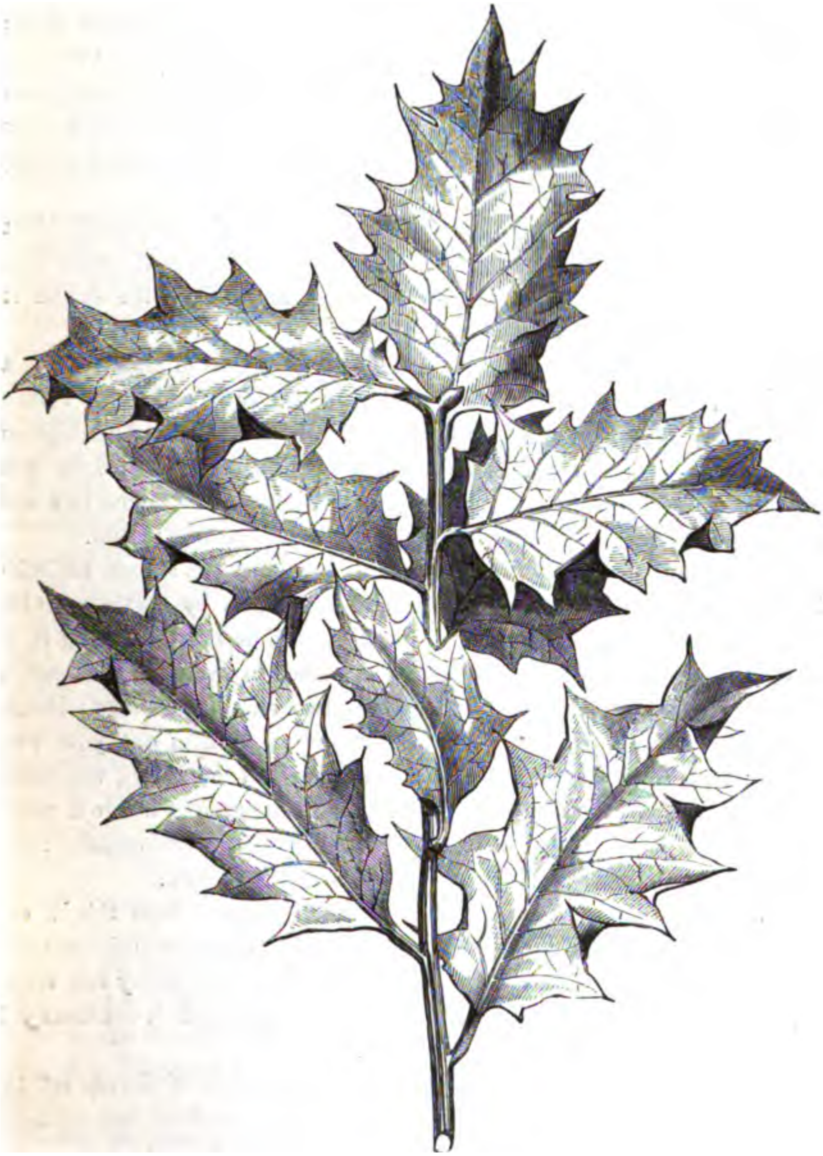
SECTION XX.—THE HOLLY.

555. The Holly (*Ilex*) belongs to the natural order AQUIFOLIACEÆ, and in the Linn. system to *Tetrandria Tetragynia*, and its generic character is thus given by Don:—Calyx 4-5 toothed, permanent. Corolla 4-5 cleft, subrotate. Stamens 4-5, alternating with the segments of the corolla. Ovary sessile. Stigmas 4. Berry containing 4-5 1-seeded nuts.

556. There are several species and varieties of this plant, some of them with spiny teeth on their leaves and others without, mostly evergreens, and

low trees or shrubs, natives of Europe, North America, and Asia. The only species, however, that I shall refer to, is the prickly leaved or common holly (*Ilex aquifolium,*) the specific character of which is—Leaves oblong,

Fig. 97.



shining, wavy, spiny-toothed. Peduncles axillary. Flowers nearly umbellate. (See Fig. 97.)

557. This is a plant the size of which depends very much upon whether it grows in a cultivated or in a wild state. In the wild state I have seldom seen it more than twenty feet high, while in the cultivated state I have seen it upwards of fifty feet, with a very respectable bulk of timber in its stem. This plant, however, is not cultivated for its timber, but almost exclusively for its ornamental effect, which is beautiful at all seasons of the year, from its being evergreen, and from its enlivening effect in winter when clothed with its clustering red berries. When an old tree of some size is cut down it is very readily sold at a good rate to cabinet-makers for furniture, and to many other tradesmen for various purposes, and among others to turners and engineers.

558. I have already, in a former section, referred to the use of this plant for hedging, for which purpose few plants are better fitted, as it forms both an impregnable fence and an evergreen, one pleasant from the shelter it affords, and from its appearance at all times.

559. The soil in which I have seen the best specimens of this plant is a light loam, with a good deal of vegetable matter in it, and dry. I have indeed seen fair plants of the common holly, both green and variegated leaved, in soil of a heavy and in that of a poor character; but I do not remember of ever seeing really healthy or well-grown specimens in a soil that did not contain a large percentage of decayed vegetable matter.

560. The holly is always propagated from seed, but the several varieties of it are so by budding and grafting, and sometimes by cuttings. Our mode of gathering and preparing the seed, as well as that of sowing it, is in every respect the same as that already described in regard to the rearing of the hawthorn. The seeds of both require two years to come up; therefore the use of land is saved one year by preparing them one year previously; that is, if the seed of these (the thorn and the holly), was sown when gathered, it would lie nearly two years in the ground before it came up, but when rotted as described, and not sown for sixteen months after gathering, it will come up the same year in which it is sown.

561. The holly is of slow growth at all its stages, and from this it will be found generally advisable to let the plants stand two years in the nursery lines before planting them out into their permanent sites, as by this mode they become well fibred in their roots and strong, which is necessary in order to insure success in their cultivation.

562. As hollies, even in their young state, say, when of the age of two years, and just when they should be removed from the seed-bed into nursery rows, are impatient of removal if the weather should be at all dry, care should be taken to transplant them only in wet weather. My own rule is to remove them from the seed-bed to the lines in wet weather about the end

of April; and although the weather should be pretty wet, we invariably give the roots a thorough watering after the first spadeful of earth is put on them. This secures the safe removal of the plants; otherwise many would certainly die.

SECTION XXI.—THE MOUNTAIN-ASH.

563. The mountain-ash (*Pyrus Aucuparia*) belongs to the natural order Rosaceæ, and in the Lynn. system to *Icosandria Di-Pentagynia*. It is a member of the same natural family or genus as the pear and the apple, the generic character of which is:—Calyx with an urceolate tube, and a 5-lobed limb. Petals roundish. Styles usually 5, rarely 2 or 3. Pome closed, 5-celled. Putamen cartilaginous. Seeds 2 in each cell. Testa cartilaginous (Don). The specific character of the mountain-ash is thus stated in the *Arbor. Britan.*:—Buds softly tomentose. Leaflets serrated, slightly glabrous. Pomes globose.

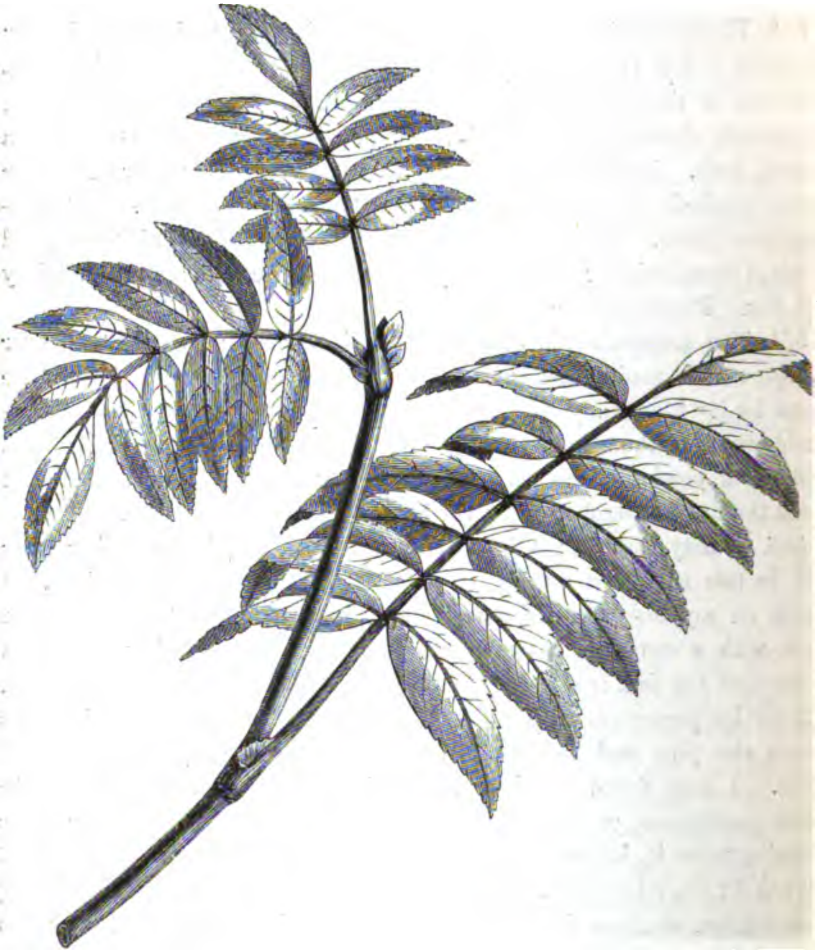
564. The mountain-ash, or rowan-tree, is a well-known plant all over Europe, and is readily distinguished from all the other species of the same genus by its beautifully *pinnate* or winged leaves, which very much resemble those of the common ash (see Fig. 98), and also by its bright red bunches of berries, which are generally ripe, and give the tree a fine effect about the first of October, when the birds begin to live on them.

565. It may perhaps not be worthy of being classed as a timber tree; still in this respect it attains, on good land, respectable dimensions. I could, on my own farm, show a tree of it upwards of twenty-five feet high, with a stem nearly two feet in diameter. I do not, however, mean to say that this is a tree worthy of being grown for the sake of its timber, but for its protection as a nurse to hard-wooded sorts on certain parts where the pine and the larch would be apt to overgrow and spoil them. I have found this tree an admirable nurse for hard woods in small plantations, or narrow beltings, as it never overtops other trees growing with it, but admits from its upright habit perfect freedom of growth for their branches. It is, besides, excellently adapted for growing as a coppice, as, from its quick habit of growth when young, it makes strong shoots within the first four or five years after being cut down, which are found to suit well for hoops, and for all sorts of rough basket-work.

566. The seed of the mountain-ash should be gathered as soon as it is ripe, as birds are very fond of it and congregate where it is, and soon devour it if the crop be not plentiful. After it is gathered, the seed for a

crop of young plants should be dealt with exactly as has been described for the preparation of the hawthorn seed. The seed of these plants lies about eighteen months in the earth before it comes up; but when rotted in a heap for some fifteen months, and sown after all the pulp has been decomposed, they come up in June if sown in the previous spring. In sowing it should be scattered thinly, say, one seed to two inches square, as the leaves, even when the plants are young, are comparatively large, and if thickly sown they would be drawn up and spoiled by crowding.

FIG. 98.



567. The mountain-ash being a very rapid-growing plant when young, it should not be kept in the seed-bed longer than one year. The plants

should, therefore, be planted out into the nursery-lines the first winter after they have sprung up in the seed-beds, and at this stage they will generally be found from eight to twelve inches high. In the nursery-lines they should be put in four inches plant from plant, and eighteen inches betwixt the rows. When they stand one year in the lines they will be about three feet high on the average, and fit for planting out.

SECTION XXII.—THE LABURNUM.

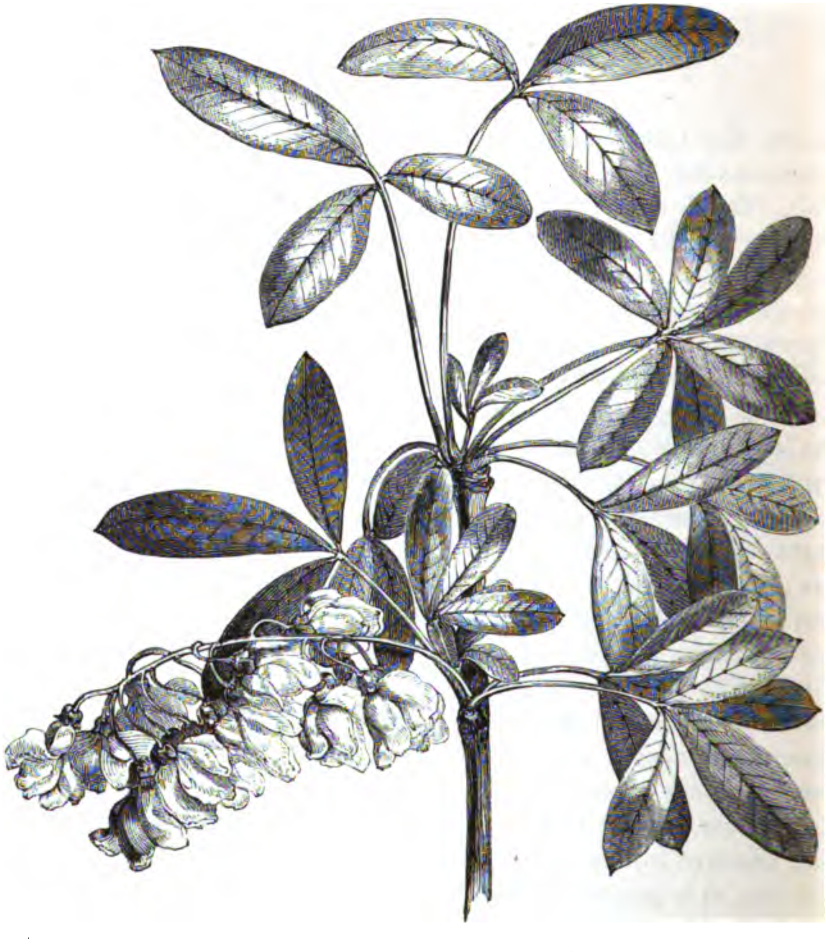
568. The Laburnum (*Cytisus Laburnum*) belongs to the natural order LEGUMINACEÆ, and according to the Linn. system to *Monadelphia Decandria.* The character of the genus is thus stated by Don:—Calyx bilabiate; upper lip usually entire, lower one somewhat tridentate. Vexillum ovate, large. Carina very obtuse, including the stamens and pistils. Stamens monadelphous. Legume compressed, many-seeded, glandless. Under this generic character is comprehended the common broom, and many other species and varieties of beautiful flowering plants, and from this description alone, therefore, it would be difficult for the young forester to distinguish the laburnum from some of the other species of the same genus, but with the following specific character of the laburnum he could not fail, if at all acquainted with the application of botanical terms—which at least he ought to be—to recognise it:—Branches terete, whitish. Leaves petiolate; leaflets ovate-lanceolate, pubescent beneath. Racemes pendulous, simple. Pedicels and calyxes clothed with closely-pressed pubescence. Legume linear, many-seeded, clothed with closely-pressed pubescence.

569. The laburnum may not perhaps be considered in the light of a timber tree, as it seldom attains large dimensions of stem; still, when left alone unencumbered, and when growing on a dry and good loamy soil, it does frequently attain a fair size, as I have seen it some thirty feet high, with a stem upwards of thirty inches diameter four feet from the ground. This, however, it must be confessed, is an extraordinary size for the species to attain, as in general it does not grow much over twenty feet in height, with a stem from eight to twelve inches diameter. I have myself sold a few old trees of the laburnum to cabinet-makers for furniture purposes, and for it I got 7s. per foot, which shows that even in point of its timber it may be turned to some account.

570. But laying out of view altogether any recommendations this tree may have as regards its timber, it has the greatest claim to our favour on account of its very highly ornamental effect. I know of no flower-

ing-tree which is more worthy of being cultivated for this purpose. In the months of June and July its bright green shining foliage mixed up with its pendulous bunches of brilliant yellow flowers, is, in my estimation, the perfection of beauty of a flowering-tree. And it is so graceful withal; notwithstanding its very showy exhibition of leaf and flower, it is of a modest and unassuming deportment. The general outline of the whole plant is irregular and natural, and this characteristic adds much to its beauty and effect. What makes this tree so very showy in its flowering season is the smallness of its leaves compared with the size of its bunches of flowers (see Fig. 99). The leaves are small, and only three on a petiole, while the flowers are numerous on one stalk, and hanging each like a bunch of yellow grapes.

FIG. 99.



571. The laburnum is worthy of a place in any collection of ornamental trees, but its proper place is on the sides of roads and walks, whether in the park, the shrubbery, or the woods—where it always forms a most agreeable object; it should have ample space for the development of its head and branches, for without a large head the tree does not form so ornamental an object as it is capable of doing.

572. The seed of this tree is generally ripe about the middle of October, when the *legumes*, or seed-pods, should be gathered for sowing. When collected, they should be stored in an airy and dry loft till they are required for sowing, which is generally about the end of March. They may be sown in any light soil, in beds, but thinly, and covered to the depth of half an inch. As the laburnum is a very rapid growing plant when young, the plants should be lifted from the seed-bed the following spring, and planted out into lines in the nursery ground, as directed in reference to the mountain-ash.

SECTION XXIII.—THE PINE.

573. The Pine (*Pinus*) belongs to the natural order CONIFERÆ, and, according to the Linn. system, to *Monœcia Monadelphia*. The generic character of this great and most useful tribe of trees is thus given in the *Arboretum Britannicum*:—"*Male flowers* in grouped catkins. Pollen contained in 2 cells, formed in the scale, that open lengthwise. *Female flowers* with 2 ovules. *Strobile* in most species ovately conical. *Carpels* or outer scales thickened at the tip, exceeding the bracteas or their outer scales in length, and concealing them; persistent.

"Leaves simple, alternate, exstipulate, sheathed, evergreen; linear, rigid, in groups of 2, 3, or 5; each group arising out of a scaly sheath. *Flowers*, males whitish yellow, powdery. Fruit a cone."

574. Of this great and important tribe of trees there are species found in nearly all the hilly regions of Europe, America, and Asia. For example, in this country, as well as in the northern parts of the Continent of Europe, we have the Scots pine; on the Pyrenees they have *P. Pyrenaica*, *P. uncinata*, and several others; while in the southern parts of Europe, they have *P. pinaster*, *P. Pinea*, *P. çembra*, and *P. rigensis*. In America, they have *P. resinosa*, *P. mitis*, or yellow pine, *P. Taeda*, *P. rigida*, *P. Ponderosa*, *P. Sabiniana*, *P. insignis*, *P. Strobus*, *P. Lambertiana*, and *P. Excelsa*, and many others too numerous to mention; while in Asia they have *P. sinensis*, *P. gerardiana*, and *P. longifolia*, &c.

575. In short, from various parts of the world, we have now had introduced into this country from fifty to sixty different species of this great

genus of trees, a large portion of them seemingly hardy enough to succeed with us, while many seem too tender for our climate without protection.

As this work professes to treat only of such trees as are known and proved to be useful for growing in our forests and plantations, I shall, in taking up the subject of pines, describe only such of the species as I have myself grown, and found from my own experience hardy enough for being reared to useful size, and to give ornamental effect. My arrangement, then, of the species I purpose to refer to, is as follows:—

1. The *Pinus silvestris*, or Scots pine.
2. The *P. Strobus*, or Weymouth pine.
3. The *P. Pinaster*, or cluster pine.
4. The *P. Excelsa*, or the lofty pine.
5. The *P. Laricio*, or larch pine.
6. The *P. Insignis*, or the remarkable pine.
7. The *P. Austriaca*, or black pine.
8. The *P. Cembra*, or cembran pine.
9. The *P. Ponderosa*, or heavy wooded pine.
10. The *P. Lambertiana*, or the gigantic pine.

These are the only species that I have myself cultivated to such an extent, and for such a length of time, as to enable me to speak decidedly in regard to them. I have found them all hardy enough even for the climate of Scotland, and have therefore no doubt or hesitation in stating that I consider these ten species to be adapted to grow well in our climate, and to become useful in every sense of the term as applied to timber trees. I shall, therefore, give a short section on the treatment of each of these sorts, and state my experience in regard to them.

SECTION XXIV.—THE SCOTS PINE.

576. The Scots Pine (*Pinus silvestris*) belongs to the natural order *Coniferæ*, and the Linn. order *Monœcia monadelphia*, and its specific character is thus given by Smith:—Leaves rigid, in pairs. Young cones stalked, recurved. Crest of the anthers very small.

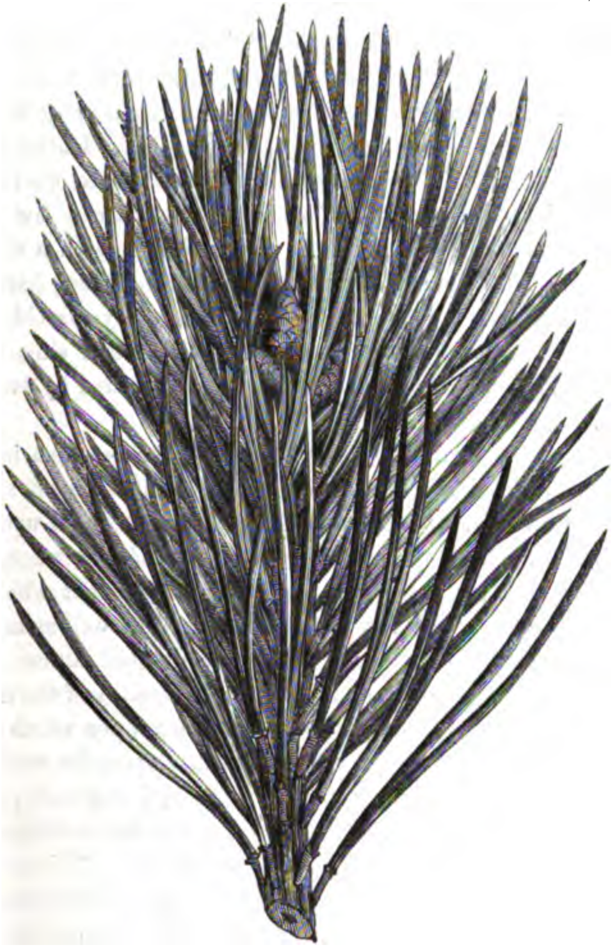
577. This species is easily recognised from any of the introduced ones, from its buds and leaves, Fig. 100. The former are what botanists call *ovate*, *blunt*, and *pointed*, and around the central one there are generally from five to six smaller ones set close round it.

In healthy grown trees the leaves are generally from two to three inches in length, slightly twisted in their length, somewhat concave on the upper surface, and convex on the under. Their colour varies from bluish green to dark green, and they are very finely serrulated on the edges.

578. This is the only one of the pine tribe which can be said to be a

native of Britain; and in so far as regards the quality and usefulness of its timber, it is at least inferior to no other species which has yet been introduced; while it becomes a tree of first-rate magnitude in favourable situations. It is one of the most hardy of our forest trees, being found in Scotland growing fully two thousand feet above the level of the sea.

FIG. 100.



579. At one period this tree must have been very plentiful in the Highlands of Scotland, and, no doubt, in many parts of the Lowlands, as is evident from the remains of trees yet growing. I may mention, in particular, the remains of the natural pine forests still existent about Invercauld, Rothiemurchus, Glenmore, Abernethy, and Duthal, where there are

by far the finest specimens of this tree to be found in Britain. Although we give this tree the name of the Scots pine, it is by no means confined to this country: it is found growing naturally in most of the countries in the north of Europe and Asia, but it is said not to be found in America. It abounds very plentifully in the north of Germany, Sweden, and Norway; and from these countries we are in the habit of importing it under the name of *red-pine timber*, which is reckoned the best quality of pine timber imported from those countries.

580. In the natural forests yet remaining in Scotland, there are found trees of the Scots pine which have attained great dimensions. Mr Grigor, in his report, which may be seen in the *Transactions of the Highland Society*, says that he girthed many of the trees in the Duthal pine forests, and found them from six to twelve feet in circumference one foot from the ground. And upon the estate of Arniston there are a few trees of the Scots pine, from six to seven feet in circumference, with a clean straight boll of forty feet in height. These trees are growing among hardwood upon the lawn, and are, in my opinion, above a hundred years old. Their tall forms contrast beautifully among the rugged oaks and elms which grow near them. They are in perfect health, and are admired by every one who sees them.

581. The quality of the timber of the Scots pine is much influenced by the nature of the soil and situation upon which it is grown, as well as by the age at which the tree is cut. The timber produced upon cold high districts in the north of Scotland, is found, when of proper age, superior to any imported from any other part of Europe; while that which has been planted and reared in the Lowlands of Scotland, as well as in rather rich soils in many parts of England, is not nearly so good, although the same age. Even within the Lowlands themselves, the quality of the Scots pine is very much influenced by the particular situation upon which it is grown. As an instance of this, I may here mention, that upon the estate of Arniston, the Scots pine growing upon the high and exposed parts of it is of excellent durable quality, while that growing upon sheltered parts of the home plantations is extremely worthless and soft. This same observation is equally applicable to every other estate in the Lowlands, the best timber always being obtained from trees growing upon a thin dry gravelly soil and a high exposed situation.

582. Relative to the quality of the timber of the Scots pine, I shall make a few remarks as to how it is affected by the age at which the tree is cut. Being daily in the habit of selling home timber of this kind, and of cutting it up for various purposes, I frequently hear carpenters and wood-merchants in general condemn our home Scots pine as inferior when

compared with pine timber from the north of Europe. Now, as I am so well aware of the prejudice that exists against the quality of our home pine, I am anxious to point out the true cause of this supposed inferiority.

I have myself cut down Scots pine trees in Scotland, which, when cut up into planks, were, by those who spoke much against the quality of our home wood, considered to be fully equal to any pine which they had ever seen imported from the north of Europe. But observe the reason. The trees referred to were above a hundred years old. The wood had got time to mature, and upon that account it was found of superior quality. Now, this points out the reason why our Scots pine timber which is planted at home is not considered of so good quality as that imported from the natural forests in other countries: it is not allowed to grow to maturity as is the case in the natural forests. I am decidedly of opinion that, where the trees in the natural forests are of the same age with those planted in our artificial forests, the quality of the wood will be as good in the one case as in the other,—circumstances of soil and situation attending each being equal.

583. In all situations, whether the natural forest or the artificial plantation, the Scots pine is slow in maturing its wood. In high and exposed parts, upon a rather poor soil, heart-wood begins to be formed when the plant is about twenty-five years of age; while, if the plant be growing upon a rich soil having some shelter, the growth of the wood will be carried on rapidly, and heart-wood may not be made till the tree is nearly forty years of age. Now, I am aware that this point is very seldom taken into consideration; and many upon this very account condemn the wood of the Scots pine as being useless, not thinking that every tree requires time to mature its wood. Even the oak itself is but comparatively worthless as a timber tree when young, and requires a time to ripen into proper heart-wood.

I am well aware that the pines growing in the forests of Strathspey are considered as good in the quality of their timber as any of the red pine from the north of Europe; and we can easily account for the superior quality of this wood as compared with thinnings of Scots pine as generally cut in the Lowlands. Mr Grigor, who examined and reported upon the Highland fir in a very minute manner, says that he found the trees in the forests of Rothiemurchus to average from one hundred and twenty to one hundred and twenty-five years; and in the forests of Abernethy he found the trees from two hundred to two hundred and forty-two years. Again, in the north of Europe, those who cut down the pine forests in order to supply our market here, do not consider the wood full grown till it is considerably above one hundred years old. In the face of this fact, how can it be justice to the tree of which we are treating, to say that, because we do not find the Scots pine in this country excellent wood when under forty years old, it is to be condemned as a worthless tree? Give it from eighty to a hundred years in order to ripen its wood, and the Scots pine will, in our home woods, produce as good timber as any got from foreign parts, if we but grow the tree in a soil and situation adapted to it.

584. There is another circumstance in the management of the wood of the Scots pine which very much affects it quality—namely, its being cut up immediately when felled. I can attest, from experience, that the wood of the Scots pine, when in a young state—and, indeed, this is the case with most other trees—if allowed to lie in the bark undisturbed for a few weeks or months after it has been felled, is sure to be worthless in the timber; but if cut up for any purpose immediately when felled, and the natural sap properly dried out of it, the wood will last three times as long as in the opposite case. Even in the case of making posts for fencing from the wood of the young Scots pine, if they are made and driven into the ground immediately when full of the natural sap, they will last but a very short time indeed; but if made immediately when the trees are felled, stripped of their bark, and exposed to the sun in order to become properly dry—say for one or two months—such posts will last double the time that they would have done otherwise. I have experienced the same thing as to wood for other purposes, having in all cases found the quality of the timber much improved by having it cut up, and the natural sap expelled, as soon as possible.

585. The uses to which the wood of the Scots pine is applicable, are almost endless. There is, indeed, no tree, the wood of which is or can be used for so many different purposes: but the most generally applicable forms are those of boards and scantlings of various dimensions.

586. Before I came to Strathspey, and before I had become so well acquainted with the nature and character of the Scots pine as I am now, I was of opinion that there were two distinct varieties of it; but since I have seen it so extensively grown in its natural habitat, I have found reason to alter my opinion as expressed on the point in the last edition of this work, and to say that there are seeming varieties indeed, but that they do not hold good during all stages of the plants that assume them. In short, I find that this tree, when closely examined, assumes various forms of the branches, and various colours of the leaves, according as it may be situated in regard to soil and situation; and therefore I am now of opinion that any varieties it may assume are merely accidental according to site and soil. On the lower parts of our natural forests in Strathspey, and where the land is comparatively good and sheltered, the tree assumes

an upright habit, while its timber is comparatively soft; while on the higher parts of the country, where the land is poor and exposed, the tree assumes generally another form, being more branchy, spreading, and flat-topped, with its timber of the best quality possible. But even these peculiarities do not hold good, and the trees generally assume all sorts of forms, and take on timber of all qualities, even on the same site, whether exposed or otherwise. In the Strathspey forests we have the Scots pine growing naturally of all ages, from the seedling rising above the heath to the tree of eighty or ninety feet high, and three feet diameter of stem, and from three hundred to four hundred years old; and having examined them at all stages, I am now of opinion that any variety there is in the tree—and varieties there are—is merely a sporting of nature as affected by the local difference of soil and site.

587. The Scots pine is entirely propagated from seed. Nurserymen are fortunately giving great attention to procuring the seeds from the native forests in Strathspey. Some of the most spirited of them have of late procured seed from trees in the native forests upon the Continent, where the *Pinus silvestris* grows of excellent quality. Plants produced from such seed are termed *Riga pines*. Few foresters have time enough to devote their attention to the gathering of the seed of the pines as found in our native forests; and even although they had, I have found from experience that the young plants cannot be raised by foresters on a small scale nearly so cheaply as they can be had from respectable nurserymen, who rear them on an extensive scale, and to whom a fair price ought to be given, in order to enable them to send out trees of the most reputable description. I am, indeed, an advocate for the rearing of young trees upon the same locality upon which they are ultimately to be planted. In order to secure this end, although we rear a quantity ourselves, I buy the most of our seedlings from a nurseryman whom I can trust as regards his giving me plants from the seed of the native trees; and after having them transplanted for one or two years into a nursery in the neighbourhood of the plantations in which they are intended to be put, I have them removed to their site.

588. Relative to the manner of raising young plants of the *P. silvestris*, I may state thus far: The cones are generally ripe in the month of December, and at that time they should be gathered. When the desired quantity is gathered, the cones should be stored past in a cool loft having a circulation of air, where they may remain till summer, when the cones must be exposed to the heat of the sun, which will open their scales and cause the seed to fall out by a gentle thrashing with a stick. When the seed has been collected, it may be stored past in a cool place, and sown in the following spring. Another process may be used, when it is wished to

have the seed sown as soon as convenient. When the cones are gathered, they may be put into sheets, and exposed to the heat of the sun every good day; and if the weather prove a little warm and sunny, the cones may be opened and the seeds thrashed out progressively by the end of March or beginning of April, when it will be time to sow. I have myself brought the seeds very quickly from the cones by subjecting them to a slight kiln heat; but as I am convinced that this is an unnatural method, and very apt to be overdone if left to an unskilful person, I in all cases object to it, and think it better to abide by the slower process of opening the cones by the heat of the sun.

589. In sowing the seed, a piece of very fine light ground should be chosen. It should be well dug, and properly cleansed from all stones, weeds, &c., as the digging proceeds. The ground being properly dug and made fine, it should be marked off into parallel beds of four feet in breadth, each bed having a path of a foot broad between it and the next. The seed should be sown pretty thickly: I may say, at an average, *four seeds to the square inch.* When sown, it should be covered by about a quarter of an inch of very fine soil. As birds are very destructive to the pine seeds, the beds should be watched for a few weeks in order to prevent their ravages. The plants are generally allowed to remain only one year in the seed beds, at which stage they are termed *one year seedlings,* and are then transplanted into nursery rows, in which, if they remain one year, the plants are termed *one year transplanted;* and if two years, *two years transplanted;* both of which sizes are planted out into the forest ground according to circumstances, which will be explained in the proper place.

590. The Scots pine is not a tree that can be said to be particular in regard to the quality of the soil upon which to grow it. The best Scots pine timber that I have ever seen, grew upon a gravelly loam resting upon a dry rocky bottom. I have observed some excellent timber of this kind in Perthshire, growing upon a very dry sandy loam. On the estate of Arniston, the best quality of Scots pine is growing upon a thin sandy surface soil, resting on a subsoil of gravelly till; and on the same estate there is also wood of excellent quality growing upon decayed rock. The natural pine forests of Strathspey are generally growing on land that may be called *sandy gravel;* on this description of land we have the very best quality of our pine timber growing, and this is on the higher parts of the forest ground. On the lower parts the land is a sandy loam; there the trees are large indeed, but not of so good quality of timber as those growing on the higher lying and gravelly land. In short, I have seen the Scots pine growing on almost every variety of soil; but I am of opinion that a light sandy or gravelly loam is, of all others, the most appropriate soil for this tree.

591. I have said in the first edition of this work, that upon a mossy soil I had never seen good Scots pine timber growing. Since writing this, however, I have had a far more extensive view of the nature of the tree, and have here to state, that in Perthshire I could point out several estates upon which there is excellent and large Scots pine growing in a deep sandy moss; it having been, previous to being planted, well drained from superfluous water. Upon the estate of Scone, also, I observed very healthy young Scots pine trees growing in a mossy soil, it having been previously well drained. My statement in regard to this has, however, been still further brought to proof since I came to take the management of the Strathspey pine forests; as in them there are large mosses on which the pine grows to very valuable dimensions, but it will, of course, not do this unless the moss is dry. To show that the Scots pine will live long, and continue in a healthy growing state in moss land, I may remark that in our Strathspey forests we have pine trees standing on this description of soil, upwards of three hundred years old, and still healthy.

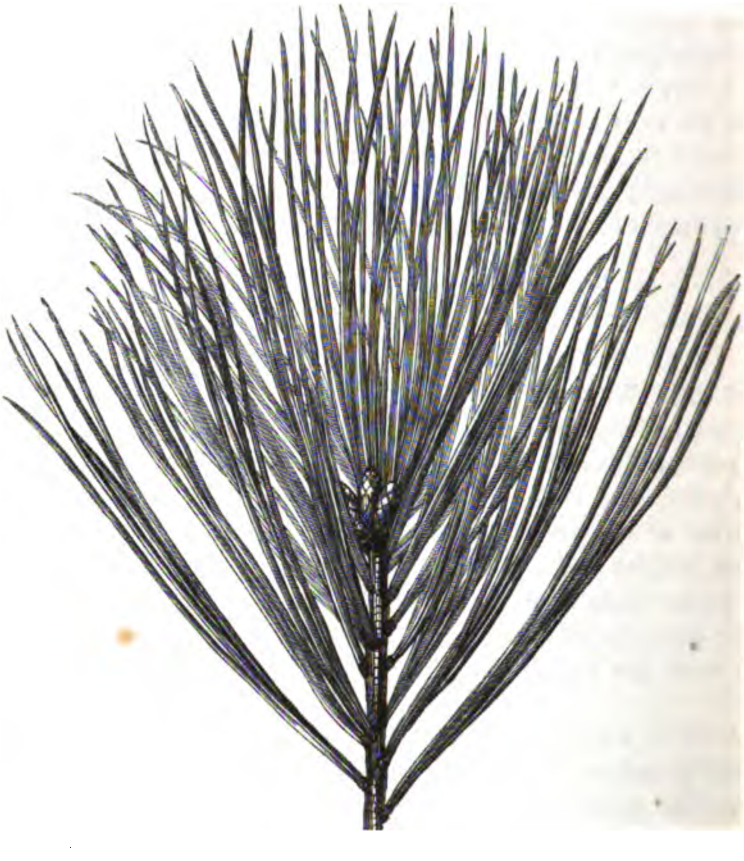
SECTION XXV.—THE WEYMOUTH PINE.

592. The **Weymouth Pine** (*Pinus strobus*) is a native of North America, has been introduced into Britain for more than one hundred and fifty years, and is said to derive its name from having been pretty extensively planted by Lord Weymouth at Longleat in Wiltshire. The specific character of this tree is thus stated in the *Arbor. Britann.*:—Leaves slender, without sheaths. Male catkins small. Cone cylindrical, long, and pendulous. Buds from 3/16 in. to 1/4 in. long, and from 1/16 in. to 3/16 in. broad; ovate, pointed, and slightly resinous; surrounded by one or two small buds (see Fig. 101). Leaves from 3 in. to 3½ in. long. (See Fig. 101.)

593. It is not a tree adapted to stand our climate in very high or exposed situations; but it is certainly an extremely ornamental variety, and in the fertile tracts of England many fine specimens are to be seen. Even in Scotland, where the soil is of a sandy loam, and in a moderately sheltered situation, there are many good specimens of this tree. In the woods about Arniston it grows very well: there is, in particular, one very good specimen, which shows that the tree is well adapted for our climate when not too much exposed. This tree is above seventy feet high, and about six feet in circumference. In the home plantations there a considerable number have been planted at one time: I should say, from the appearance of the trees, about fifty years ago. They

generally look well, and are tall healthy trees, about fifty feet high. In thinning plantations, I have had occasion to cut down many of them, and find the wood, when at or under forty years, to be extremely soft and short-grained. When used for paling or any out-door purpose, it lasts but a very short time, being not nearly equal in this respect to our Scots pine when young. Some years ago, I cut down two pretty large trees of this species upon the estate of Arniston. From their appearance, I should say they were about eighty years old. I sold them to a carpenter in the neighbourhood, who cut them up for some house-work, and he informed me that the wood is very short-grained and comparatively worthless, and not nearly equal to our Scots pine or spruce fir. Seeing, therefore, it is not a pine likely to be useful for general purposes in this country, I never, for my own part, plant any of it in the plantations ; and I merely advert to it here in order to give my opinion of the quality of the

FIG. 101.



timber of the tree. But as an ornamental tree it stands very prominent when in a situation adapted to its nature, which seems to be upon a light dry loam, and in a sheltered situation, with at the same time free air to allow of the tree expanding its branches. The leaves of this tree are easily distinguished from most of the other pines, by being five in a bundle, or in fives, from three to four inches long, of a light bluish green, with longitudinal silver lines, *scabrous*, and finely *serrated* on the margin. In summer the leaves hang free and loose, but in winter, and particularly during frost, they contract and lie close to the branches.

594. Although the Weymouth pine is not much valued in this country for its timber qualities, still, in America, it is said to be more used than any other sort of pine timber; and I believe that it is from this tree that the Americans chiefly procure the masts of their ships.

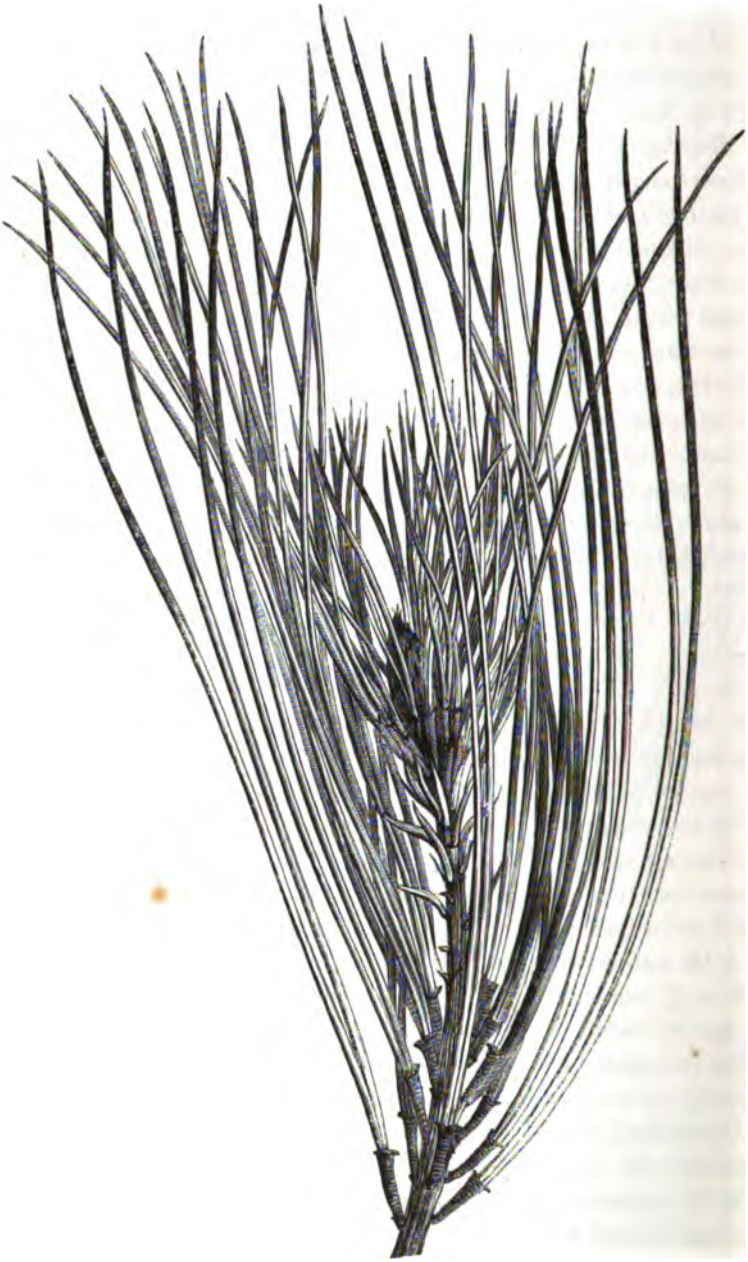
595. This tree, like all the others of the pine tribe, is raised from seeds, which are generally ripe in this country about the end of October. The cones are easily opened, and the seed extracted from them. When the cones are gathered and the seed taken from them, it should be sown about the end of March or first of April, and dealt with in every respect as recommended for the rearing of the Scots pine.

SECTION XXVI.—THE CLUSTER PINE.

596. The Cluster Pine (*Pinus pinaster*) is thus specifically characterised in the *Arboretum Britannicum*:—"Leaves in pairs, rigid, very long. Cones conical, placed in whorls of three, four, or even as many as eight together, rather solitary, much shorter than the leaves; the backs of the scales forming each a rhomboidal pyramid with two lateral angles, from which proceed ribs, terminating at the summit of the pyramid in a smaller pyramid, which has a hard point, more or less sharp, and of a grey colour. Crest of the anthers rounded. Bud (Fig. 102) from ⅝ inch to ¾ inch long, and from ⅜ inch to ½ inch broad; straight-sided, cylindrical, with the scales turned back; white and woolly, but never resinous; surrounding buds few and small. Leaves (see Fig. 102) from 6 or 8 inches to one foot in length, slightly serrated on the margins; sheaths from ½ inch to ¾ inch in length, imbricated, scarcely rigid, pale green or whitish at first, and becoming at last black. Cones from 4 inches to 6 inches in length, and from 1¾ inch to 2½ inches wide at the broadest part, light brown and shining; scales from 1 inch to 1¼ inch in length, and from ½ inch to ¾ inch in breadth at the widest part, terminating in a regular pyramid, rhomboidal at the base. The summit consisting of a smaller rhomboidal pyramid of

an ash-grey colour, very hard, and with a small sharp point, more particularly in the upper part of the cone. Seeds oblong, and measuring, without the wing, upwards of ⅜ inch in length, and nearly ¼ inch in breadth, with

Fig. 102.



the wing above 1¾ inch in length, wing nearly ½ inch in breadth. Cotyledons seven or eight.

597. This is not a tree which can be recommended for ornament, nor for the value of its timber. As regards both these qualities, it is surpassed by our common Scots pine. There is, however, one point of superiority which it possesses in a high degree, and that is its hardihood in withstanding the blasting influences of the strongest sea-breezes of our climate; and it is in regard of this that I recommend the cultivation of the *P. pinaster*.

During my experience as a forester, I have frequently had occasion to remark, that hardy as the pinaster is in withstanding the influences of the sea-breezes, it is but a tender plant when planted in a high elevated part of the country inland. This no doubt arises from its being a native of low situations along the sea-coast of the south of Europe. It is, therefore, properly speaking, a tree not adapted for profitable culture in inland plantations, seeming, so far as I have been able to judge correctly of it, to incline to the neighbourhood of the sea. Upon the estate of Dunskey, which runs partly along the sea-shore from Portpatrick towards Stranraer, the pinaster has been plentifully introduced along the higher grounds bordering upon the sea-shore, in order to form a protection to the plantations of hardwood growing inside. It has answered the desired end there, having grown rapidly and healthily, securing in a very few years an amount of shelter which could not have been obtained by any other sort of tree. These pinasters, however, were by far too thickly planted, and were not attended to in the way of thinning; hence I have no hopes of their attaining such size and value as they would have done had they been more thinly planted, and thinned as they grew up.

598. Upon more elevated parts of the estate of Dunskey, the pinaster was also planted, at, I should say, from four to five hundred feet above the level of the sea; but in such parts the plants did not succeed well, and consequently their cultivation upon these elevated inland parts was given up. When I left that place, General Hunter Blair, the proprietor, meditated planting the pinaster extensively along the sea-coast, having seen the advantages of it as a protection to his lands in that quarter. The pinaster being a tree which stands the sea-breeze with impunity, and being also of a branching spreading habit when young, it ought to be planted thinly—say at from four to five feet apart; and in forming plantations of it along the sea-shore, I should recommend the following method of going to work.

599. Line off a broad belt of land all along the length of the coast to be planted, not less than two hundred yards in breadth; and as a fence to this, upon the side next the sea, erect a stone dyke if possible, in order the more readily to bring away the trees by having a little shelter from the sea. But

if stones for this purpose are not to be got conveniently, erect a turf dyke of about four feet in height. The fence inside may be a hedge or otherwise, as taste or local circumstances may suggest. Care must be taken, upon all juttings of land bending out into the sea, to make in the line of fence a bold convex bend in the same direction, this being in addition to the general width. Having the fence erected, plant the ground all over with Norway maples and sycamores, of each an equal number, at about twelve feet apart; that is to say, if the land be of anything like a loamy nature, and adapted to the growth of those trees. Having the hardwood planted, make up all the spaces between them with good strong plants of the pinaster, till the ground all over have young trees averaging four feet apart. The hardwood plants will not come away rapidly, and will in all probability die down to the ground the second year after being planted. But the proprietor must not be at all discouraged upon this account, for it is quite natural that the young plants should do so, as they must suffer a very severe check by being at once transplanted from a nursery to the open ground upon the sea coast. In order to strengthen the young maples and sycamores as much as possible, when they have remained one year upon the forest ground, have them all cut over by the surface of the ground, and the year following they will set away young shoots, which will bear the climate they rise in; the more so, as by this time the pinasters will be beginning to grow rapidly, and cause a little shelter over the ground. If the ground intended for the pinasters be of a sandy nature, it would not be advisable to plant either maples or sycamores upon it; therefore, in such a case, it will be much better to plant the ground all over with pinasters alone; for although the maple and sycamore both stand the sea-breezes well, still if the soil upon which they are planted be not of a loamy nature, they have not much chance to rise to any good, but would remain small unsightly things. The pinaster, on the other hand, being a plant that grows in the poorest sandy soils, will, instead of being injured by being planted even upon the sea sand, actually flourish upon it. It must not be expected that the pinasters will rise high, or make fine-looking trees, for a number of years. On the contrary, they will spread rather low, and form a very bushy habit for at least the first twelve years. This habit of theirs is their security; for a tree that would incline to rise high in such a situation would be at once thrown into bad health, while the pinasters, spreading themselves, soon form a complete massive shelter to everything else near them; and by the time they arrive at about fifteen years old, they begin to rise upwards rapidly, being by this time perfectly established in their situation.

600. Great attention is necessary, in the cultivation of the pinaster, to

see that the trees be kept at all stages of their growth from interfering much with one another in their side branches; for if they are ever allowed to confine one another so far as to grow up weakly, they cannot be easily redeemed again: this I have had frequent occasion to observe. The roots of the tree are few compared with those of the other pines we are in the habit of cultivating. These, if the trees are confined, become weak and slender; and if thinning be attempted after the roots have been once weakened by confinement, they will never recover their healthy state, so that the blowing down of the greater part may be expected. Therefore, in all cases, pinaster plantations should be kept thin, and the winds allowed to have play upon each tree, which is the very life of them. Where the Norway maple and sycamore are cultivated among the pinasters, these should be pruned at a very early stage, and caused to take a pretty upright habit, in order to keep as many of the pinasters upon the ground as possible for the first twenty years. In doing this, I do not mean that the hardwoods should be drawn up weakly. On the other hand, they too should have free air about them; but by keeping their side branches pretty closely pruned in, their branches will not interfere much with the pines, which will, of course, admit of a free circulation through the wood, and keep the whole in a more healthy state. Further, in all cases where the maples and sycamores appear to be any way in a state of bad health, let them be at once cut down in the course of thinning, and the pinaster left in preference. In planting the pinaster at four feet separate, it must not be understood that at that distance the trees can stand unthinned till they are of a useful size. Some practical foresters have, indeed, recommended to plant this tree at eight feet apart, stating that if so managed, the young trees will come in for use at the first thinning. I have seen them planted at that distance, but found the trees so managed a few years longer in producing the desired effect than when planted at from four to five feet; and being aware of this, and that proprietors in general are more interested in having the desired end quickly produced, than in the mere saving of the expense of a few extra plants upon the acre of land, I would advise the planting to be done at about four feet apart; by which means shelter will be quickly produced, and additional value be given either to other plantations inside, or to grain crops or live stock in the fields. When planted at the distance mentioned, as soon as the trees begin to interfere a little with one another, thin out a part; and if no useful purpose can be found for them, let them be destroyed as best may be. Indeed, although the young trees cut down at the first thinning can be turned to no use, a decided advantage is gained by having the plantation more quickly brought forward than could be the result were they planted at a wider distance.

601. The pinaster is propagated from the seed, which is generally procured from the continent of Europe. The seeds are pretty large, and when in the bed ought to be covered by about three-quarters of an inch of fine earth. They should be sown about the middle of April; or, when the season was late and inclined to frost, I have sown them on the 1st of May. The young plants rise up quickly, and become comparatively stout the year that they are sown. Having few fibrous roots, it is often a matter of some difficulty to get the young plants to transplant with safety when of any size. The manner of going to work in the rearing of this plant, so as to secure a supply of fibrous roots at it, is as follows:—

When the seedlings are one year old—that is to say, if the seed was sown in the end of April 1859, in the end of April 1860 I lift the plants from the seed bed, and transplant them all into nursery rows. In doing this I proceed thus:—I have a piece of ground proportioned to the number of plants to be put out, previously prepared by frequently digging it during the winter, and exposing it as much as possible to the influence of the frost. This piece of ground should be of an open, free, sandy nature, with no dung upon it; such as has been under a crop of pease the previous summer answers well. The ground being thus prepared, I take out the opening from one side of the plot and wheel it to the opposite, in order to close with when finishing. I next dig over the earth all along the opening (not too deeply if there be any bad subsoil) until I have fully six inches in width dug and levelled. Having this done, I place the garden line about six inches from the edge of the plot, and give a slight beat with the back of the spade all along the length of the line, with the view of making the earth all smooth and level. The line being tightly placed, and the run of the ground under it level to satisfaction, I next proceed to cut out an opening for the plants all along the line, merely so deep as to hold easily their roots and to cover them about half an inch deeper than they stood in the bed. This being done, I allow the line to lie, and take a few plants in the left hand, and place them, resting on the side of the opening, about two inches separate from each other; and upon the roots of each plant put into the cut by the left hand, I put a little fine soil with the right, which keeps them in their place until the whole length of the row is finished. In this manner I proceed with the whole length of a row. When I have arrived at the end of the line, I take the spade, beginning at the one end, and put a little more soil upon the roots and necks of the plants all along. This being finished, I tramp with my foot slightly the newly put-on earth, with the view of making the soil a little firm about the roots, and keeping out the drought. I again take a little more earth and put it to the plants, as much as will again make up a level of six inches of ground from the first row made. Next I lift the line; measure six inches from the row of plants put in at each end, or from the line before it is lifted; place the line to that measurement for a new row, and in the same manner I proceed until the whole of the plants are put in. Above all things, observe to do this work on a wet day, and never when the sun shines, nor when any dry, cold wind blows; because if so, the plants will suffer much, and very likely very many of them will die. Therefore I particularly recommend the removing of the pinaster seedlings in dull, cloudy, or rainy weather. Another point to be particularly attended to is, to see that the plants are carefully lifted from the bed; and in order to this, let them be carefully loosened with the spade, endeavouring not to strip one fibre from their roots; but, on the contrary, try to take a little of the soil with the roots rather than strip them bare of it. If this is not attended to, many of the plants will, without doubt, die; but if attention is paid to these points, the plants will succeed well.

602. When the plants have remained one year in this state, they ought to be lifted again in the beginning of May following; and by this second transplanting they will make excellent fibrous roots. In lifting them this second time, attend to the same rules already laid down for the first transplanting; only, in transplanting the second time, let the distance between the plants be about three and a half inches, and that between the rows twelve inches. When they have remained in these rows for one year, they will be ready for transplanting out into the forest ground.

603. In lifting the plants from the nursery ground, in order to place them in their ultimate stance, have the work done in a very careful manner, or it will most assuredly be a failure. Have the plants lifted with a part of the earth attached, and by no means allow one fibre to be broken. In planting upon the ground, have a few men employed taking off turfs, about two inches thick and twelve inches square, from the exact spots where it is intended the plants are to be put in; which turfs, as they are taken off, should be divided into two equal halves, and one half put to each side of the space bared. This being done, before the man leave the spot where the turf is taken off, he should loosen the earth with his spade, but not make a pit; and in this manner any number of men may proceed in preparing for the plants.

Immediately behind the men employed making spaces for the plants, have twice that number of men, each with a boy and plants, coming on planting; that is, one person preparing should keep two planting behind him. In planting, the man with his spade makes a sufficiently large opening in the centre of the bare ground, to admit of the roots of the plant being properly put in. This being done by a boy, and the plant held by him in an upright position, the man with his spade returns the soil all carefully about the roots of the plant, and tramps it firm. Finally, the turf should be put on the opening from which it was taken, but with the earth or under side uppermost, making it meet close upon the plant upon each side; and when it is thus placed on, the seam or opening in the middle of the turf must be neatly and closely fitted together, by using a little of the earth from each of the edges of the turf. It should receive a good tramping with the feet over all; all this being intended to keep out the drought in the early part of the summer until the plants take root; and in this manner the work should be carried on till the whole is finished. The planting of the pinaster should never be done sooner in the season than the middle of April, and even then let it be, if possible, in dull or damp weather.

SECTION XXVII.—THE LOFTY PINE.

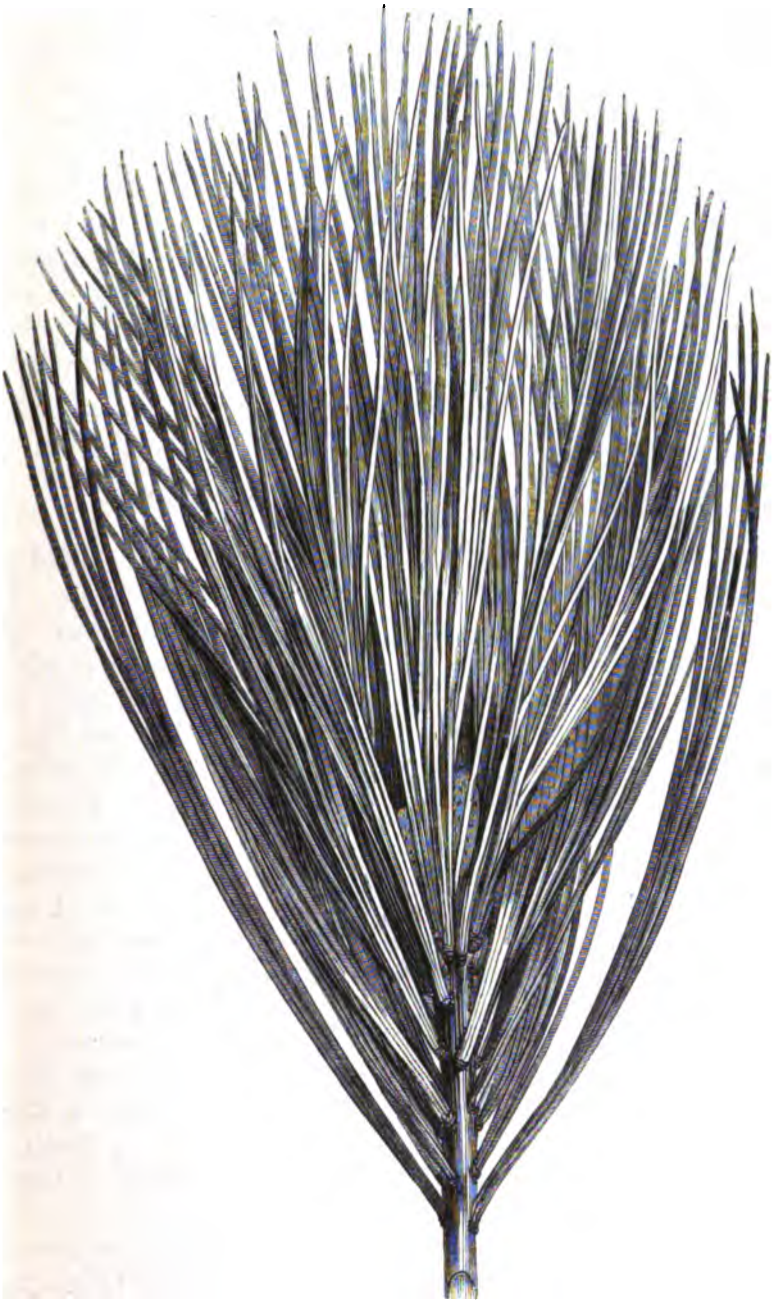
604. The Lofty Pine (*P. Excelsa*), is thus described in the *Arbor. Brit.*:—Leaves in fives, very long and slender, loose. Crest of the anthers roundish, truncate; simple, lacerated. Cones cylindrical, smooth, pendulous, longer than the leaves. Buds, on the tree in the Horticultural Society's garden, $\frac{1}{4}$ inch long, and $\frac{3}{16}$ inch broad; conical, with straight sides, and pointed (Fig. 103). Leaves rather more than 6 in. long. Cone 9 inches long, and 2 inches broad, with a foot-stalk 1 inch long; scale $1\frac{3}{4}$ inch long, and $1\frac{1}{3}$ inch broad. Seeds, $\frac{5}{16}$ inch long, and $\frac{3}{8}$ inch broad, with the wing $1\frac{1}{4}$ inch long, and $\frac{3}{8}$ inch broad. A large tree. Nepaul, on mountains, height 90 feet to 120 feet. Introduced in 1823. It flowers in May, and ripens its cones in the autumn of the second year. "*Pinus excelsa*," Mr Lambert observes, "approaches so near in habit, and in the shape of its cones, to *P. strobus*, that were it not for the simple round membranaceous crest of the anthers, it would be almost impossible to distinguish them specifically. The leaves are longer than in *P. strobus*, and the cones are thicker."

605. I have confidence in stating that this is a tree in every respect hardy enough for the climate of Britain generally, and my opinion regarding it is that ere long, in all moderately sheltered parts of the country, it will be largely planted, both for ornament and for its timber. It is a rapid growing tree, but seems to be somewhat impatient of high winds and storms; in a sheltered site, however, it stands well, grows rapidly to height, and is withal a handsome tree. To grow it well, however, it should be either planted in a mass by itself, or among other trees, say larch.

606. While at Arniston I planted a considerable number of this tree, as

an experiment, with regard to its hardihood, among Scots pine and larch

FIG. 103.



when making a young plantation, about 1000 feet above the level of the sea. There they succeeded well, and in fact outstripped the S. pine in the lengths of their annual shoots; so that, from this proof, I have no hesitation in saying that the *P. excelsa* is well adapted to grow to useful dimensions in this country, and, therefore, to prove useful as a timber tree. Of course, I am not prepared to say what the quality of the timber is likely to be, as I have not seen specimens of it old or large enough to satisfy me on this point.

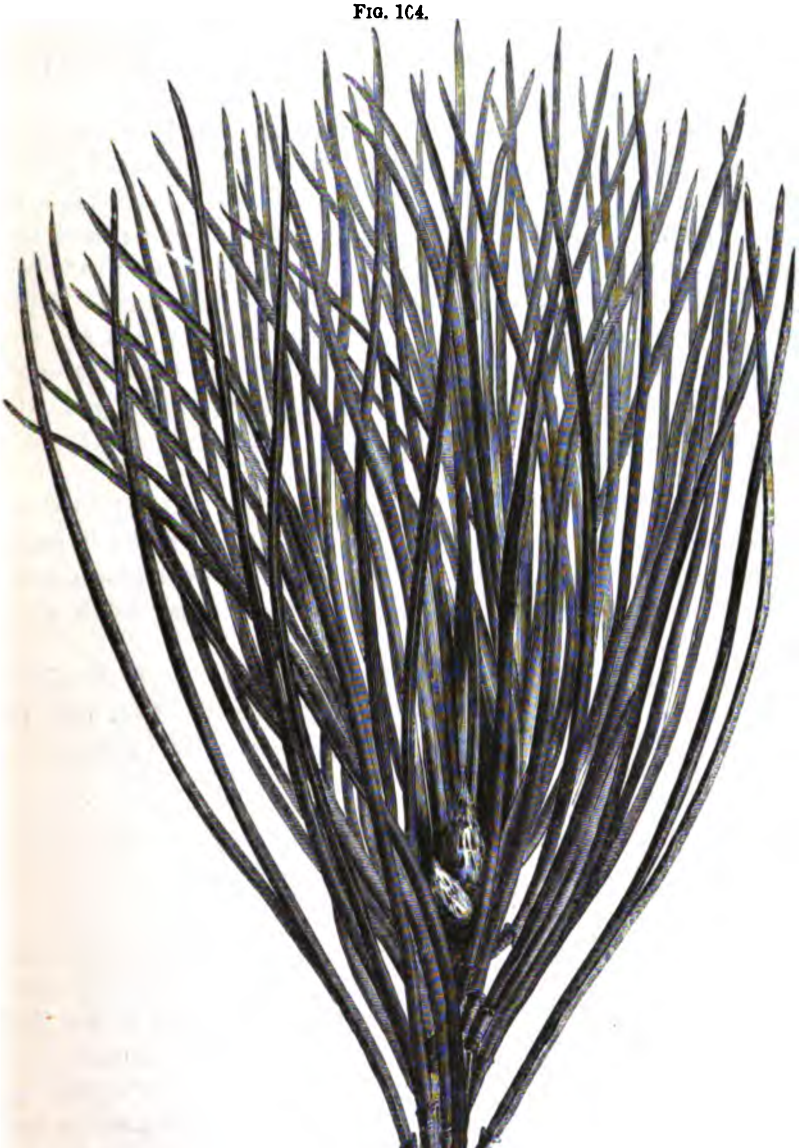
607. This tree is raised from seeds, when they can be had; but a large portion of the plants we get from nurserymen are only branches of the sort engrafted on stocks of some commoner pine. We cannot have this tree cheap (it is now 1s. 6d. each plant) for general planting, till we have a larger supply of it than we yet can get, and till the older trees are able to produce a plentiful supply of seed; of course, as this comes about, we will have the plants gradually more cheaply supplied.

SECTION XXVIII.—THE CORSICAN OR LARCH PINE.

608. The Corsican or Larch Pine (*P. Laricio*) is thus described in the *Arbor. Britan.*:—" Leaves lax, twice the length of the cones. Cones conical, often in pairs, sometimes, but rarely, in threes or in fours. Scales convex on the back, elliptic in their general form, scarcely angular, and very slightly pointed. Male flowers almost sessile, elongated, having the anthers terminated by a small round crest. Bud (see Fig. 104) from ¾ inch to 1 inch long, and from ⅜ inch to ½ inch broad; ovate, with a long narrow point, and concave at the sides, resembling a camel-hair pencil. Scales adpressed, and encrusted with white resin. The centre bud generally surrounded by three or more small buds. Cones varying from 2 inches to 3 inches or more in length; and from ¾ inch to 1½ inch in breadth. The points of the scales turned over like an under lip, and terminating in a point, which has a very small prickle, often scarcely perceptible. The colour of the cone tawny, and the interior part of the scales purple. Leaves varying in length from 4 to 6 inches and upwards; generally two in a sheath on the side branches, but occasionally three on the leading shoots. Seeds greyish or black, twice as large as those of *P. silvestris.* Cotyledons 6 to 8. A lofty tree. Corsica, Spain, Italy, Greece, and various parts of the south of Europe, the Hartz in Germany, and Caucasus in Russia; generally on deeper soil than *P. silvestris.* Height, 60 feet, 80 feet, 100 feet, 150 feet, according to the variety, the climate, and the soil. Introduced in 1759. It flowers in May, and its cones are ripe in November of the second year."

609. This pine, from its having now been about 100 years introduced

FIG. 104.



into the country, is plentiful, and therefore easily obtainable; the price of the plants, two year seedlings, one year transplanted, is this year 25s. per 1000. It is easily known from any other of the recently-introduced pines by its very rapid and upright growth, by its strong leaves, which are rather thinly dispersed over the shoots, and by the terminal buds of its shoots being comparatively long, and tapering to a point.

610. In my opinion, there are none of the pines that have been introduced into this country that promise to become so useful as the one now under notice. It is a hardy tree, grows well in a great variety of soils, and is a rapid and free grower. Even in this country, it grows much more rapidly, and attains a larger bulk of timber, in a given time, than the Scots pine, all circumstances alike. I have grown it to some extent (experimentally) among larch and Scots pine, in many different soils and sites, and in them all it surpasses the Scots pine in its annual growth, generally making from 18 inches to 24 inches of leading shoot each year, while under similar circumstances the Scots pine makes only from 12 to 18 inches.

611. As a timber tree, I have no doubt it will yet be found valuable in this country, and therefore strongly recommend it to be grown in masses, either by itself or among larch; but as it is of very rapid growth, and as its wood is comparatively soft when young, I should advise that it should not be planted closer than five feet, tree from tree.

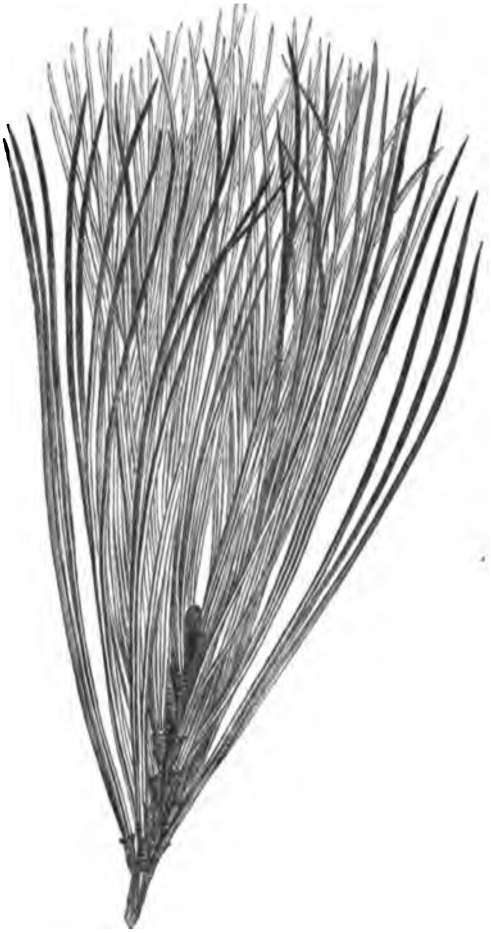
612. The seeds of this tree can be got in abundance from the Continent; and as they are at least twice as large as those of the Scots pine, they should be sown considerably thinner in the beds, and covered a little deeper.

SECTION XXIX.—THE REMARKABLE PINE.

613. The Remarkable Pine (*P. insignis*) is, I think, one of the most ornamental of all the genus, at least of those that are found hardy enough to stand our climate. Its specific character is thus stated in the *Arbor. Britan.*:—"Leaves three, and occasionally four, in a sheath; much twisted, varying greatly in length, longer than the cones, of a deep grass green, and very numerous. Cones ovate, pointed, with the scales tuberculate. Buds (see Fig. 105) of the side shoots of young plants from ⅛ inch to ¼ inch long, and from ¼ inch to ⅜ inch broad, brown, and apparently without resin; on the leading shoots a great deal larger, and resembling in form and almost in size, those of *P. Sabiniana*. Leaves, in Douglas's specimen, from 3 inches to 4½ inches long; on the plant in the Horticultural Society's garden, from 5 inches to 7 inches long. A large tree.

California. Introduced in 1833, and requiring protection in British gardens, at least when young."

FIG. 105.



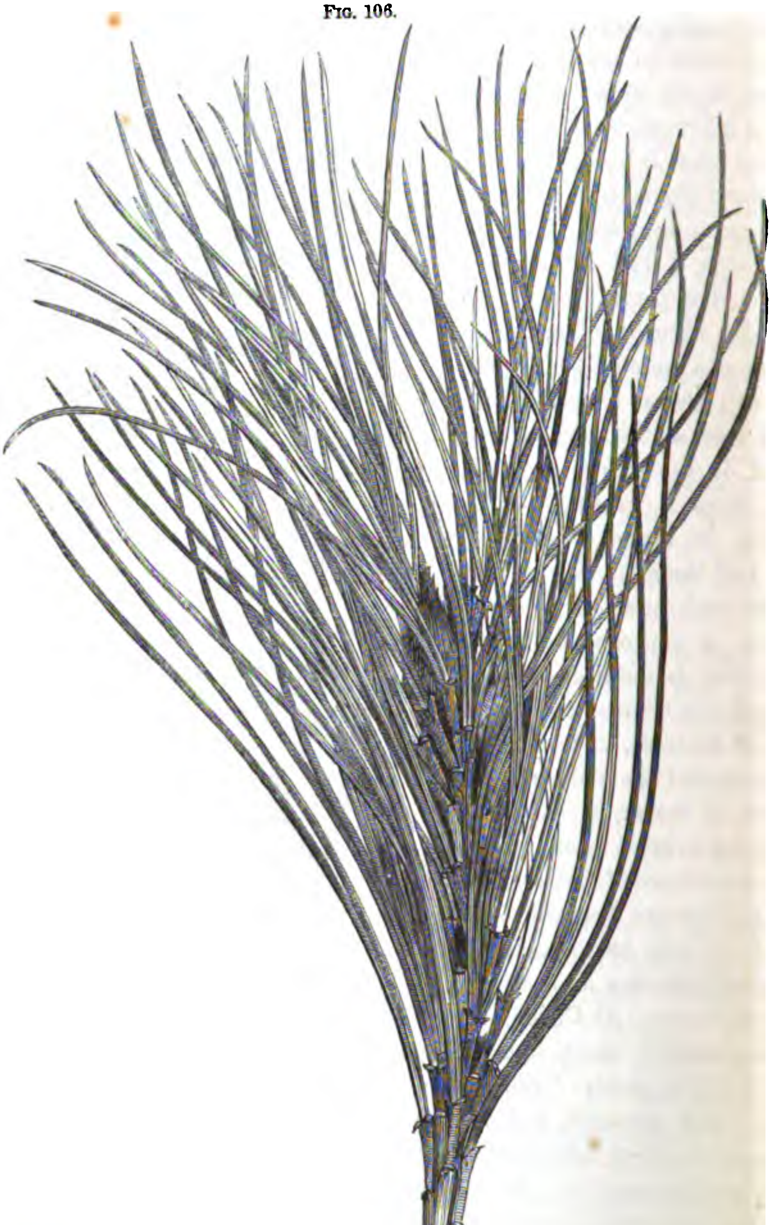
614. For my own part, I cannot altogether agree with Mr Louden in his last statement in the above quotation from his work, as I have not found the *P. insignis* of so tender a character as he would lead us to suppose. While at Arniston, I had a few specimens of it planted out in the woods, amongst other young trees, and there I found it quite hardy; and at Cullen House, the seat of the Earl of Seafield, in the county of Banff, we have it growing beautifully, in rather a sheltered part of the grounds; so that, from such proof of its hardihood, I am convinced that the tree is quite adapted to stand our climate, and to become valuable, at least as an ornamental one, and even, perhaps, as timber, if judiciously planted in home woods. From my experience of the tree, however, I am not disposed to say that it will be suitable for general planting as a timber tree on any site that might be called an exposed one. At Cullen, the plant has now stood three years, and has made annually shoots from 18 inches to 24 inches.

615. The plants of this species are still comparatively rare, and the seed not easily procured, and nurserymen rear them chiefly by grafting the young shoots of such plants as they have got upon stocks of a commoner and cheaper species. At present, small plants, 9 inches high, cost from 2s. 6d. to 3s. each. It thrives best in a light, deep, dry soil.

SECTION XXX.—THE BLACK PINE.

616. The Black Pine (*P. Austriaca*) is thus described in the *Arbor.*

FIG. 106.



Britan. :—"Sheath with from 3 to 5 rings, at first of a clear ash-grey, then becoming reddish, afterwards darker, and at last black. Leaves from 2 inches to 5 inches long, seldom, and but little, twisted: when young, erect; when older, standing out, and curved towards the twig; outer surface half round, dark green, glossy, and with a sharply serrated margin; inner surface nearly even, but slightly dotted along the ridge; points prickly, of a yellowish brown or fawn colour. Buds (see Fig. 106) large, the leader often from 1 inch to 1¼ inch long, ovate, with a long point. The cone does not arrive at maturity till October in its second year; it is conical, rounded at the base, 2 or 3 inches long, pointing horizontally, or nearly so, of a light yellow brown, polished, and shining. Seeds very closely resembling those of *P. Laricio;* and the cotyledons 6 or 8, as in that species. The bark of the shoots of the current year is of a greenish yellow, regularly and deeply raised by the insertions of the leaves, furrowed, and shining. A large tree. Austria, in the Breima Forest (Wienerwald), the Banate, upon the Demoglet, near Mehadia, and in the neighbourhood of the Snowy Mountains, at higher altitudes than *Picea pectinata.* Height, 60 to 80 feet. Introduced in 1835. It flowers about the end of May, and its cones are ripe in the October of the second year."

617. This tree is readily known from all the other pines introduced into this country, by its very strong and robust habit of growth, by the stiffness and strength of the leaves, and by their prickly points. Any one having once carefully examined it, will not afterwards mistake it for another species, as there is a natural robustness in its whole habit which distinguishes it from all the other pines.

618. It is undoubtedly one of great hardihood; in fact, in this respect it is not exceeded even by the Scots pine. At Arniston, 1000 feet above the sea-level, I planted it among Scots pine and larch, and it grew luxuriantly, and made even more rapid progress than the other sorts. Besides its hardihood, it has the advantage of a very natural and irregular outline in the distribution of its branches, and from this I consider it a tree worthy of a place in an ornamental point of view.

619. Although I have not seen any old trees of the species, I should say, judging from its general appearance and habit, that it is destined to become of very considerable importance in this country as timber. It is well known to be greatly valued for general purposes in Austria, even as the *P. silvestris* is in this country.

620. Although it has been introduced into this country only some twenty-four years, still the cost of the young plants is comparatively moderate. This year (1859) two years' seedlings, one year transplanted, are got for 15s. per 1000. This of course arises from the seed

being easily procured from the Continent, where it is indigenous. The seeds are a good deal larger than those of the Scots pine; and in sowing them, therefore, they should be more thinly distributed on the bed than that of the Scots pine, and a little more deeply covered.

621. In planting it out into forest land, as it is of a free-growing and rather spreading habit, it should be distributed at distances not closer than five feet. It will thrive well on any light land, but it must be rather deep, open, and moderately dry. In saying moderately dry, I mean that the tree, so far as I have had experience of it, is not so liable to be injured in its health by a little wetness in the subsoil as others of the pine tribe are.

SECTION XXXI.—THE CEMBRAN PINE.

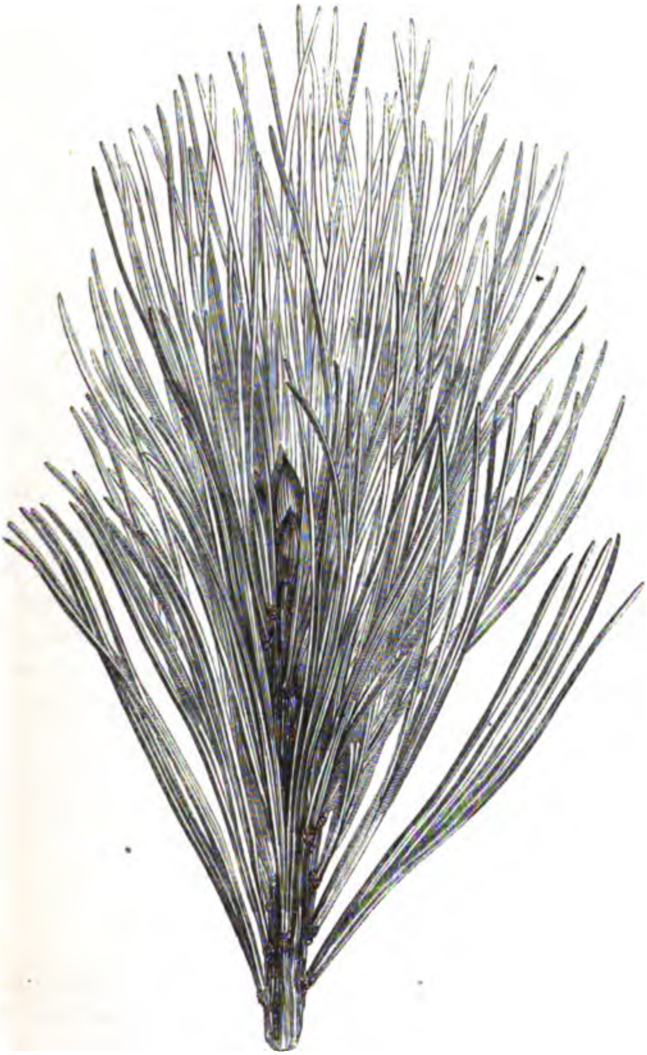
622. The cembran pine (*P. cembra*) is thus described in the *Arbor. Britan.*:—"Leaves in fives (see Fig. 107); sheaths deciduous. Cones ovate, erect, about as long as the leaves, and having, when young, the scales pubescent; the wings of the seed obliterated; anthers having a kidney-shaped crest. Buds (see Fig. 107) from $\frac{1}{4}$ inch to $\frac{3}{8}$ inch broad; globose, with a long narrow point; white and without resin; not surrounded by smaller buds. Cones about 3 inches long, and $2\frac{1}{4}$ inches broad. Scales 1 inch long, and about the same width in the widest part. Seed larger than that of any other European species of pinus, except *P. pinea*, $\frac{1}{2}$ inch long, and $\frac{5}{16}$ inch broad in the widest part, somewhat triangular, and wedge-shaped; without wings, probably from abortion, and having a very hard shell, containing an eatable, oily, white kernel, agreeable to the taste. Cotyledons 11 to 13. A tall tree. Switzerland and Siberia. Height, 50 feet to 80 feet. Introduced in 1746. It flowers in May, and ripens its cones in the November of the following year."

623. This is perhaps one of the hardiest of all the pine species, and is very readily distinguished from the others by its erect habit of growth, the shortness of its annual shoots—they very seldom exceed ten inches—and by its branches being regularly disposed in whorls from the bottom of the stem to its top. It is of very slow growth at all its stages, and even when young, as in the generality of soils, I have seldom seen it advance more than eight or nine inches in any one year, so that from this it is not generally much planted as a timber tree.

624. I planted a number of the *P. cembra* in young plantations while at Arniston, and chiefly among larch and Scots pine, but I found that in a few years, from their very slow growth, they became overtopped by the other trees, and did not generally succeed well from this cause. I think, there-

fore, that, generally speaking, it is not a tree adapted to grow among others of a more rapid growth, and that it should either be planted as a nurse to slow-growing hardwoods, or in a mass by itself. I have planted it experimentally in our woods in Strathspey, and find it as hardy as our native Scots pine; but in the cold climate and poor soil of the district, it makes very slow progress indeed; not over six inches of young shoot annually.

FIG. 107.



625. As it is a very pretty tree, and regular in its habit of branches, I think that it is exceedingly well adapted to stand alone as an ornamental

specimen. In planting it for this purpose, however, attention should be had not to place it near any spreading and rapid-growing sorts, as in such a situation it would not succeed satisfactorily, without the removal of such other trees from it as might interfere with it. I should, therefore, recommend its being planted chiefly along the sides of drives in woods, and along the sides of roads and walks in pleasure-grounds ; or if in a plantation, in a mass by itself.

626. The timber, when matured, is said to be of fair quality, but rather soft. Of course in this country we have no experience of its timber qualities, but it is said to be much used on the Continent for wainscoting and joinery purposes, as it is of a light-brown colour when matured.

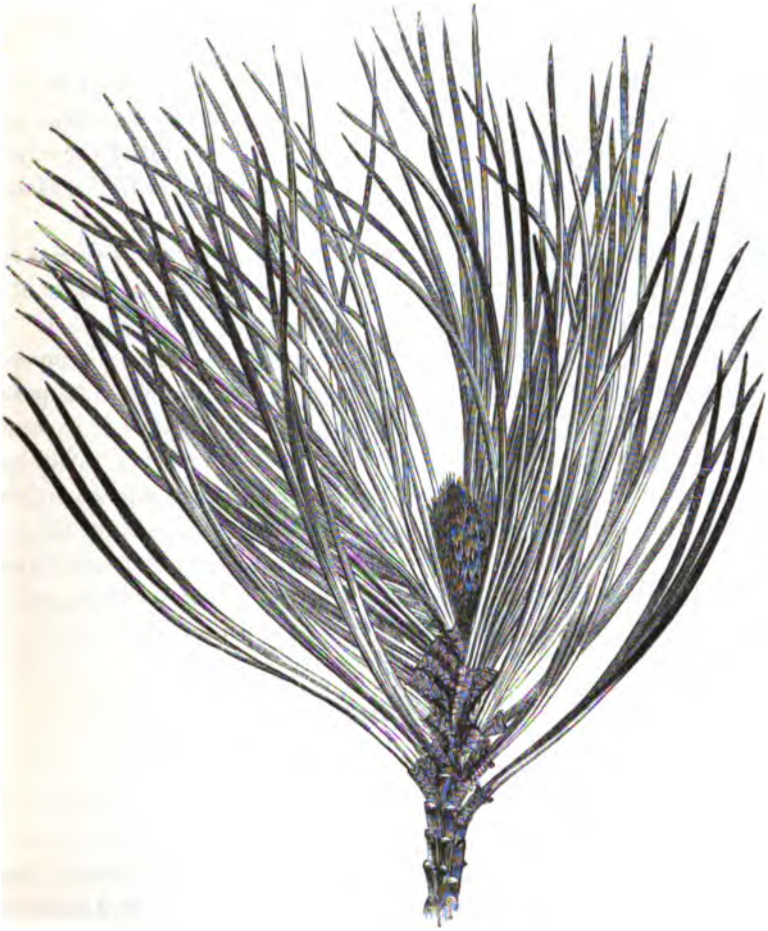
627. This species is propagated from seeds imported from the Continent. As the seeds lie eighteen months in the ground before germinating, they should be sown immediately when received. Some keep the seeds one year in a rot-heap, mixed with earth, before sowing them, as by this means the land upon which they are to be sown may be otherwise occupied for a year ; and as the seeds are large, they should be sown thinly, and covered with ¾ inch deep of fine earth. The plants are very easy of cultivation, as they are fibrous rooted, and therefore easy to manage in the way of transplanting. The better way is to give them two summers' growth in the seed-bed before removal into the nursery lines, as even then they will be but small things comparatively. After standing two years in the nursery rows, they will not generally exceed one foot in height, and at this stage they should be planted out into their permanent sites, as, if allowed to stand much longer, their growth receives a check from transplanting, and consequently they require the longer time to establish themselves, so as to grow as fast as their nature will admit of. This tree will succeed in any soil and situation on which the Scots pine will ; but of course the better and stronger the land it is on, the more rapidly will it attain respectable size. The cost of two years' seedlings, two years transplanted, is about 40s. per 1000.

SECTION XXXII.—THE HEAVY-WOODED PINE.

628. The heavy-wooded pine (*Pinus Ponderosa*) is thus described in the *Arbor. Britan.*:—" Leaves three in a sheath, much longer than the cones, flexible, tortuous, with short sheaths. Crest of the anthers rounded, entire. Cones ovate, reflexed, with the apices of the scales flattened, with a raised process in the middle, terminating in a conical, minute, recurved spine, and slightly quadrangular. Buds, in Douglas's specimen, ⅞ inch long, and ⅜ inch broad ; cylindrical, with straight sides, rounded like a dome at the ex-

tremity, but with a prominent blunt point; dark-brown, and covered with resin. Buds on the living tree (see Fig. 108) from 1 inch to 1⅓ inch long, and from ⅜ inch to 1½ inch broad; smooth, cylindrical, with a long point; reddish-brown, and covered with a fine white bloom, consisting of fine particles of resin, surrounded by two or more smaller buds. Leaves disposed in parallel spirals, and from 7 inches to 9 inches long (see Fig. 108). The cone in Douglas's specimen is deformed, and very imperfectly developed; it is only 3 inches long, and ¾ inch broad. The scales are terminated in flattened processes, scarcely ribbed in any direction. In the centre of the process is a protuberance, large in proportion to the scale, which terminates in a sharp prickle, pointing outwards.

FIG. 108.



Scale, 1 inch long, and $\frac{3}{8}$ inch broad; dark-brown. Seed, $\frac{5}{16}$ inch long, and $\frac{2}{8}$ inch broad; dark-brown, with the wing nearly 1 inch in length, and $\frac{3}{8}$ inch in breadth; wings of a yellowish brown. A lofty tree. North America, on the north-west coast. Height, 50 feet to 100 feet. Introduced in 1826. The plants, when of ten or twelve years growth, are remarkable for the twisted appearance of their branches, which are in regular verticillate whorls. The timber of full-grown trees is said to be so heavy, as almost to sink in water."

629. I have found this a very hardy species of pine, and I think that it is likely to become valuable as a timber tree in our forests and plantations. But of course we cannot have it so cheaply as to admit of its being used extensively for many years yet, and until we can procure the seed of it freely. I am not aware whether it has flowered and borne cones at all in this country, as it has only been introduced some thirty-three years. At Arniston I planted it, and found it succeed well, and at Cullen House I have it growing satisfactorily.

630. As yet, a number of the plants I have got of this species from nurserymen are reared from engrafting branches of it on the stocks of the common pines; still there are now and then small quantities of seed imported, and ere long we have no doubt they will be more easily procured, as the trade with the far west of America is opened up. At present nurserymen sell the plants, from eight to twelve inches high, at 5s. each.

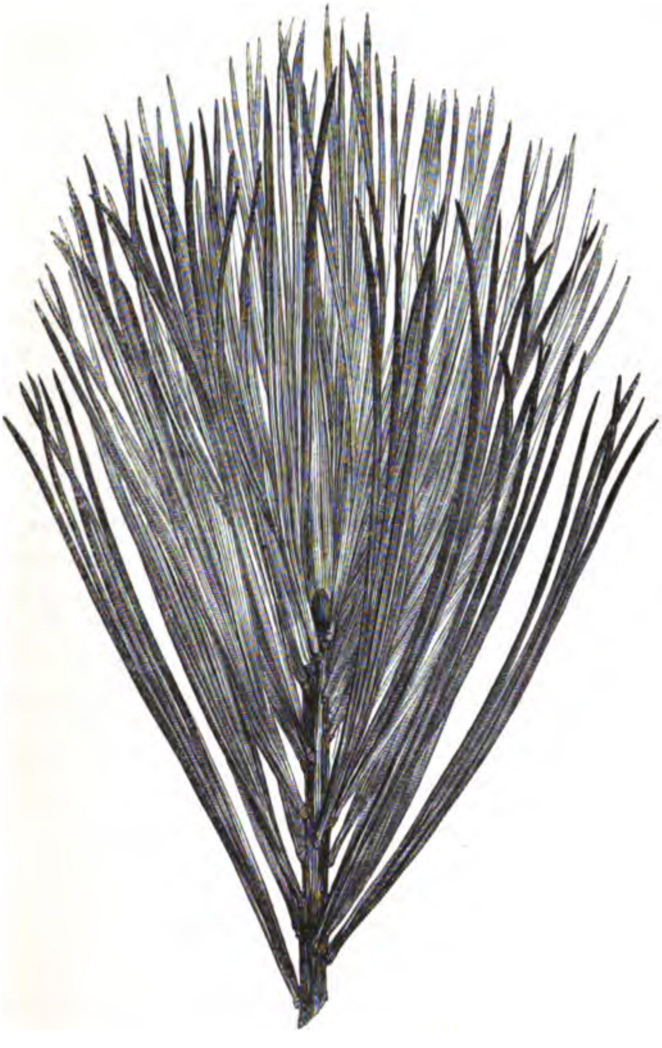
631. I have found this species succeed best on a light, dry, sandy loam. The soil, however, should not be too strong or rich, nor the site too sheltered, as under such circumstances the plants generally grow too luxuriantly, and consequently do not ripen the points of their shoots sufficiently to resist the frosts of our winter; but when on a moderately good soil, and fair exposure, they ripen their shoots, and stand our winters well.

SECTION XXXIII.—THE GIGANTIC PINE.

632. The gigantic pine (*P. Lambertiana*) is, in the *Arbor. Britan.*, described as follows:—" Leaves in fives, rigid, roughish; sheaths very short. Cones thick, very long, cylindrical; scales loose, roundish (*Douglas*). Buds (see Fig. 109), $\frac{1}{8}$ inch long, and $\frac{1}{8}$ inch broad; roundish, pointed, and with 3 smaller buds. Leaves, $2\frac{3}{4}$ inches to 3 inches long (see Fig. 109). Cones from 14 inches to 16 inches long, and said to be sometimes 18 inches long, and 4 inches in diameter in the widest part; scales $1\frac{1}{2}$ inch wide, and nearly 2 inches long. Seed large, oval, $\frac{7}{8}$ inch long, and nearly $\frac{3}{8}$ inch broad; dark brown, wing dark brown, and, with the seed, $1\frac{3}{4}$ inch long, and $\frac{5}{8}$ inch broad in the widest part. A gigantic

tree. California, upon low hills, east of the range of the Rocky Mountains, covering large districts. Height, 150 feet to 200 feet, rarely 215 feet. Introduced in 1827. Native of the north-west coast of North America, where it was discovered by Mr Douglas, and introduced into England in 1827."

Fig. 109.



633. I have planted out this pine also, both at Arniston and at Cullen House, and find it as hardy as the *P. Ponderosa*, and I think it is as likely to become valuable in our forests as a timber tree as that one. As to the quality of the timber of either the one under notice, or of the *P. Ponderosa*, I am not prepared to speak, as the trees of the species have not arrived at such a stage in this country as to enable me to judge of them in this respect. Judging, however, from the general appearance of this tree, from its hardihood, and from the texture of its stem and branches, I am of opinion that it will ultimately become a valuable acquisition to our forests. At present this one is even more rare than the *P. Ponderosa,* as it still sells at 7s. per plant of six inches in height. For the mode of rearing it, as at present practised by nurserymen, see the remarks made in paragraph 630 in reference to the *P. Ponderosa.*

SECTION XXXIV.—THE FIR.

634. The Fir (*Abies*) is another genus of the natural order CONIFERÆ, and according to the Linn. system is in the same order as the pine. Its generic character is thus stated in the *Arbor. Britan.*:—" The same as Pinus, but with the cones pendent, and less decidedly grouped; the *strobiles* cylindrically conical; the *carpels* not thickened at the tip, and the *leaves* solitary, partially scattered in insertion, and more or less 2-ranked in direction. *Carpels* and *bracteas* adhering to the axis of the strobiles (D. Don). *Leaves* simple, 2-rowed, exstipulate, evergreen, linear. Flowers in catkins, the males yellowish. Trees evergreen, natives of Europe, Asia, and America, remarkable for their tall, erect, pyramidal forms and profusion of foliage. In Britain they flower in May and June, and ripen their cones in the spring of the following year."

635. This is also a very valuable genus of tree, but the principal one of them that has yet been grown for timber in this country is the spruce fir, or Norway spruce, which is a lofty and majestic tree. This genus is easily distinguished from the pine by the tall pyramidal form of its species, by their more rapid growth, and by the comparative weakness of their branches, which seldom attain timber size, and which gradually die off as the trees grow old. But besides this characteristic, the trees of the Abies family are still more readily distinguished from those of the pine by the disposition of their leaves on the branches. In the pines the leaves grow from the shoots two or more in a sheath (see Fig. 110), while in the firs the leaves grow singly, and are scattered chiefly on the upper sides of the branches (see Fig. 110, *b*).

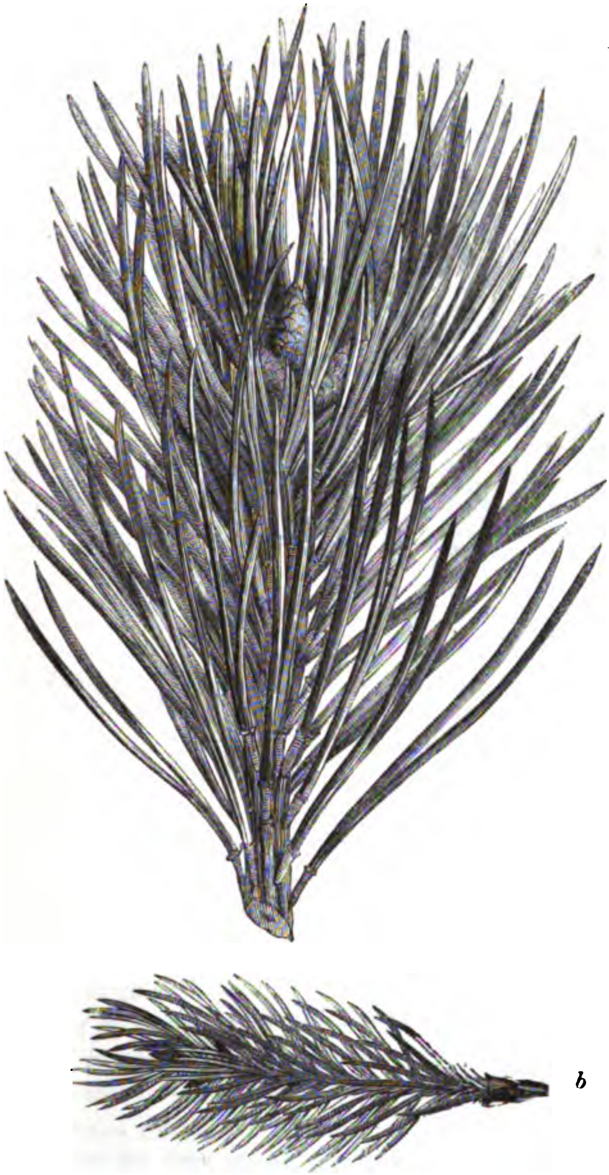
636. The fir is a tree that generally attains maturity much earlier than the pine, and seldom lives long after arriving at its maturity.

637. The only species I shall refer to of this genus are—

1st. The *Abies excelsa,* or Norway Spruce Fir;
2d. The *Abies Khutrow,* or Khutrow Fir; and
3d. The *Abies Douglasii,* or Douglas's Spruce Fir.

The first is well known and established in this country as a timber tree, and the other two are the most promising of all the sorts that have been introduced, in respect to the freeness of their growth, and to their likelihood to become valuable as timber trees in our woods.

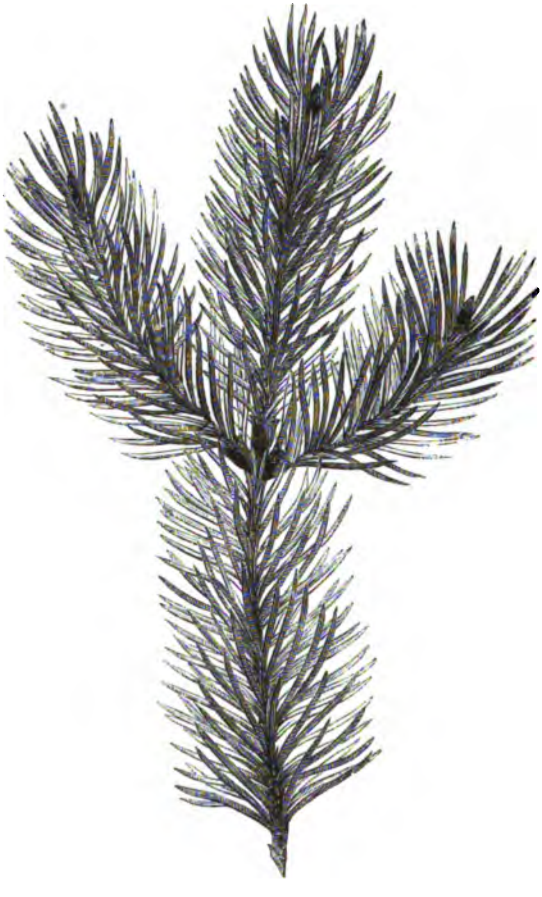
Fig. 110.



SECTION XXXV.—THE NORWAY SPRUCE FIR.

638. The Norway spruce fir (*Abies excelsa*) is thus specifically described in the *Arbor. Britan.*:—" Leaves scattered, quadrangular (see Fig. 111). Cones cylindrical, terminal, pendent; scales naked, truncate at the summit, flat. Crest of the anthers rounded (Lois). Cone from 5 inches to 7 inches long, and from 1½ inch to 2 inches broad; scale from 1 inch to 1½ inch long, and from ½ inch to ¾ inch broad. Seed very small, scarcely ⅛ inch long and 1/16 inch broad, with the wing ¾ inch long and ¼ inch broad. Cotyledons 7 to 9. A lofty tree. North of Europe, more particularly Norway; height, 80 to 100 feet; cultivated since 1548. It flowers in May; its cones are ripened in the spring of the following year, soon after which they commence shedding their seeds."

Fig. 111.



639. This tree is a native of most of those countries which occupy the north of the European continent, especially abounding in Norway, Sweden, and Russia. It is one of the tallest of the European coniferæ, except, perhaps, the *silver fir*, which is frequently found taller; but as a stately, well-formed tree, particularly when standing alone with full spread of branches, few trees are more admirable.

640. It grows in a peculiar pyramidal form. The bole rises like a perpendicular stalk, clothed with proportionally small feathered horizontal

branches from bottom to top. These, when the tree stands free and alone, gradually become smaller as they are found high upon the tree; thus giving the tree almost a perfect cone shape.

641. This tree naturally inclines to grow in what may be termed a dampish situation; and in Britain it is found to succeed best in a rather sheltered part. Indeed, upon a high site, if much exposed to cutting winds, the tree seldom attains anything like a respectable timber size in this country; more particularly if the soil upon which it is planted be of a dry, sandy, or gravelly nature, the tree generally becomes rotten at heart long before it arrives at anything like a useful size. To illustrate this point of situation more particularly—a point of great importance in the cultivation of this tree—I shall give an example or two from the spruce fir plantations at Arniston, showing how, by soil and situation, the spruce varies much upon the same estate. In a sheltered glen behind Arniston garden, there are spruce fir trees from eighty to ninety-five feet high, with a diameter near the bottom of from two to three feet; and generally these trees are in good health. The soil upon which they grow is in many places a stiff blue clay; in other places a clay loam; and in a few instances it is a sandy loam. These trees being nearly all alike situated as regards shelter, I find that the largest and healthiest-looking trees are those growing upon the clay loam; and next to them, those growing upon stiff clay; the least healthy being those growing upon the sandy loam. As these trees are all of the same apparent age, I conclude from what I have observed, that, other circumstances being alike, the spruce fir will thrive best upon a loamy soil, and worst upon an open, dry, gravelly one. In other sheltered parts upon the estate of Arniston, there are large healthy spruce fir trees growing upon an open gravelly soil, where the roots have a supply of water oozing through the gravel. Upon another part of the estate are trees of good size growing on a deep mossy soil, which rests upon a bed of sand. These last-mentioned trees are growing most rapidly, the situation being on a sloping brae, and the roots have the advantage of a constant supply of water as it oozes up into the moss out of the sand below: therefore I am convinced that, in order to grow spruce timber of large size and healthy constitution, the soil must contain a good proportion of moisture, or at least be what is termed moist, but not stagnated. Again, higher up on the outer plantations, where there is not much shelter naturally, I find the spruce fir succeeds pretty well on any loamy soil, and even on a stiff clay, provided it be drained from surface water. In such situations there are trees fifty feet high, and eighteen inches diameter at bottom, at thirty-eight years of age, the trees being still in a vigorous, healthy state, and likely to become of much larger dimensions. Again, at the

same elevation as that upon which the trees last stated are growing—namely, seven hundred feet above the level of the sea—spruce firs of the same age, but growing upon a gravelly dry soil, I find generally not more than thirty feet high, from eight to twelve inches diameter at bottom, and in general rotten in the heart; which at once points out that the spruce fir, in a high site as well as in a low, prospers much better upon a somewhat dampish soil than upon a dry one. Again, in the younger plantations, situated about nine hundred feet above the level of the sea, I find the same qualifications of soil relative to the tree hold good. At the elevation last mentioned, I could point out the spruce fir rotten at heart, and not more than twenty years old; and that occurs upon a dry gravelly soil.

642. The timber of the spruce fir is, next to that of the *P. silvestris*, the most useful for boards, planks, and roofing scantlings which we have in this country. It is of excellent quality when of mature age, being very light and pliable. The quality of the wood of this tree, however, is, like that of the *P. silvestris*, much influenced by the nature of the soil and situation upon which it is grown. When grown upon a dry soil, the wood is brittle and short-grained; but when grown upon a dampish loam, it is quite of an opposite character.

I must make an observation here, which I have often found verified by my own experience—namely, the spruce fir, when young and immatured, yields a far more durable timber than the Scots pine at the same age. In erecting paling-fences, I find that, taking the two trees for rails at thirty years old, the spruce will last two or three years longer than the other; and even as a gate-post or common paling post, the same observation holds good. Notwithstanding this superiority of the wood over that of the Scots pine, country carpenters are always ready to recommend the Scots pine in preference to the spruce, even for such purposes as those mentioned above; and I make this observation in order that proprietors may be aware of the true state of the case.

643. The spruce fir is propagated in exactly the same manner as the *P. silvestris;* and the observations given regarding the gathering of the cones, and taking out and sowing the seed of it, are in every respect applicable to this tree, except that in the present case the seed is ripe and should be gathered in the early part of spring. The spruce fir, however, is much slower in growth than the *P. silvestris* while in its seedling state. The seedling plants remain two years in the seed-bed, but they generally require three years in the nursery-rows before they are fit for being put into their final situation in the forest. Many recommend the spruce as being an excellent nurse for hardwood trees; but I cannot assent to this opinion.

So far as my experience enables me to speak confidently upon this matter, I must confess that I have found the larch and Scots pine far superior for this purpose. The spruce fir, as a nurse for hardwood, and for oaks in particular, is too rapid in the early stage of its growth, often confining the oaks too much by the spread of its massy branches, as well as injuring the roots of the trees it is meant to protect. The spruce fir has very fibrous matty roots, which spread in every direction along the surface of the soil. Now these, from their matted closeness, keep the air from penetrating properly into the soil for the benefit of the hardwood, which send their roots deeper down; consequently much injury is often done by this means; and this I have frequently seen proved. The spruce fir, as also all the coniferous tribe, are best suited for timber when planted in a mass by themselves; but seeing that it is proper, and even necessary, to have a proportion of them planted for the benefit of nursing up our hardwood plantations while in a young state, I recommend planting the spruce but sparingly for that purpose, having found the Scots pine and larch answer much better.

SECTION XXXVI.—THE KHUTROW FIR.

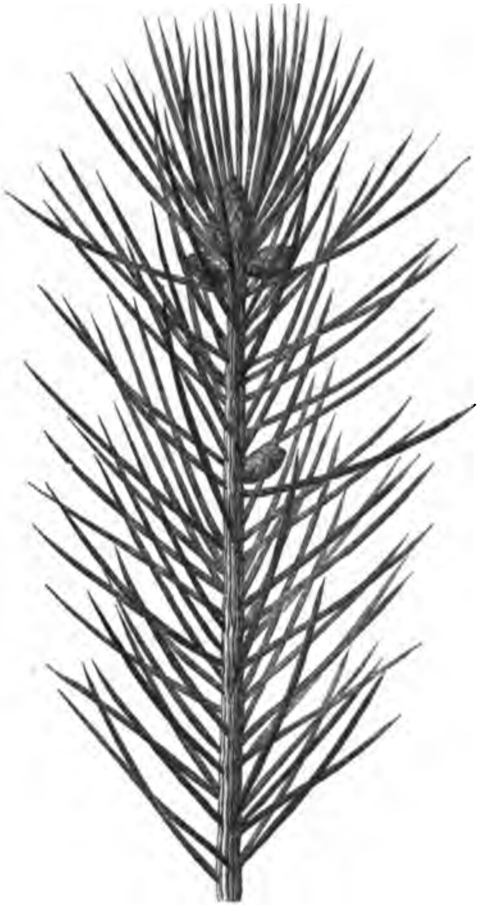
644. The specific character of the Khutrow Fir (*Abies Khutrow*), is thus stated in the *Arbor. Britan.*:—"Leaves compressed, tetragonal, straight, awl-shaped, sharp-pointed. Cones ovate-oblong; scales obovate-roundish, coriaceous, rigid, smooth on the margin. Crest of the anthers roundish, irregularly crenated (D. Don). Leaves from 1 inch to 1½ inch in length (see Fig. 112). Cone 6 inches long, and 2½ inches broad; scale 1⅛ inch in length, and the same in breadth at the widest part. Seeds about the size of those of the common spruce; with the wing ⅞ inch long and ⅜ inch broad. A pyramidal drooping branched tree. Himalayas, in Kamaon and Sirmore. Height 50 feet. Introduced in 1818."

645. This is a free-growing hardy species of *Abies*, and well worthy of a place, either as a tree in plantations, or as an ornamental one in the park. Its growth is about as rapid as that of the common spruce; from which it is easily distinguished by its leaves being of a lighter green, as well as by their greater length.

646. As this species is now comparatively cheap, nine-inch plants being charged one shilling each, I have planted out a considerable number of them in the woods both at Arniston and in Strathspey, and find them quite hardy and free growers, even in the latter part of the country; I

have therefore no doubt of its becoming generally useful as a timber tree in the country. I think it will grow well in any soil and situation in which the common spruce prospers, and, like it, it succeeds best upon a good strong soil, not rendered too dry, and in rather a sheltered site. In my experience of this species, I have observed that it is very impatient of confinement among other trees, and does not succeed if any way shaded, or on land in which there are old roots of old trees, or on which a crop of timber has lately been grown. In this respect, therefore, it is different from the common spruce, as that tree is well known to succeed comparatively well although planted under the shade of other trees.

FIG. 112.



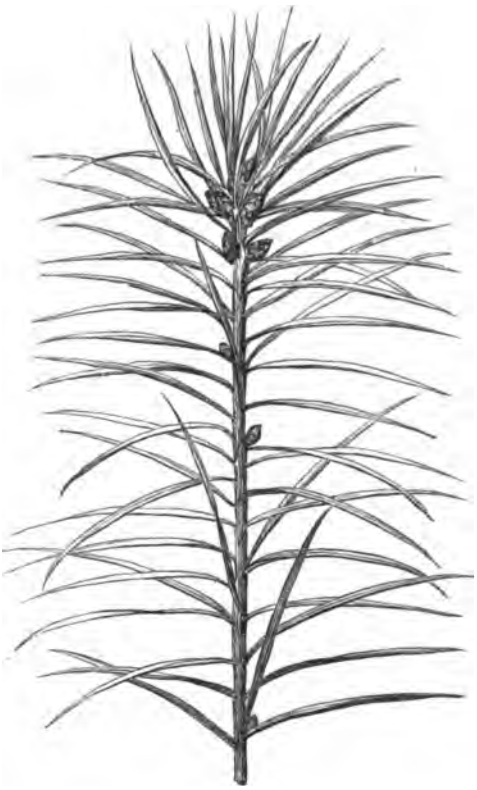
647. The Abies Khutrow is readily propagated from cuttings of the young wood, but plants thus raised do not grow so freely as those raised from seed. Considerable quantities of seed are being now imported, however, and ere long we may, therefore, expect to have the plants from this source so cheap as to enable us to plant them in our woods more extensively.

SECTION XXXVII.—DOUGLAS'S SPRUCE FIR.

648. The specific character of Douglas's Spruce Fir (*Abies Douglasii*), as stated in the *Arbor. Britan.* is as follows:—"Leaves (see Fig. 113) flat, blunt, entire, pectinate, silvery beneath. Cones ovate-oblong. Bracteas elongated, linear, 3-pointed (D. Don). Leaves from 1 inch to 1¼

inch long. Cones from 3¾ inches to 4 inches long, and 1½ inch to 1¾ inch broad; scales, without the bractea, 1⅛ inch long, and the same broad; with the bractea, 1¾ inch in length. Seed, with the wing, ⅞ inch long, and ⅜ inch broad; without the wing, ¼ inch long, 3/16 inch broad. The seeds are about the same size as those of picea pectinata, but more oblong. A tall tree. North-west coast of North America, in forests. Height 100 feet to 180 feet. Introduced in 1826. It flowers in the climate of London in May, and its cones are matured in the June or July of the following year."

FIG. 113.



649. This is an admirable tree, but more tender than the preceding species. Apart from the specimens I have seen growing at various places in England, where it is quite hardy enough for the climate, it thrives well in the midland and southern counties of Scotland; but in the northern and high-lying parts of the country, as in Strathspey, it does not succeed, from the want of heat to mature its shoots in the autumn, and from the great degree of cold which follows in winter. In all the low-lying parts of the country, however, even in the north of Scotland, it seems hardy enough, and grows freely; nearly as rapidly as the spruce fir. Generally speaking, I think that this tree is not adapted to grow profitably as a timber tree in plantations on high-lying parts of the country, but is very suitable both for plantations and for ornamental culture in low-lying and sheltered sites; and I have no doubt that on such parts it will ere long become a valuable tree, even in point of its timber, while its very ornamental habit will make it gradually more sought after and cultivated.

650. This tree is now pretty extensively reared from seeds, both

imported and those taken from trees of home growth, and compared with many others of the Abietinæ, it is cheap, as plants eight inches high can be procured at 2s. each.

SECTION XXXVIII.—THE SILVER FIR.

651. The Silver Fir (*Picea*) also ranks in the natural order CONIFERÆ, and the Linn. *Monœcia Monadelphia.* The character of the genus is thus stated in the *Arbor. Britan.*:—"The same as in Pinus and Abies, but differing in having the cones erect. Strobile cylindrical, with its carpels not thickened at the tip. Both carpels and bracteas separate from the axis of the strobile. The leaves are obviously two-ranked in direction. Leaves simple, two-ranked, exstipulate, evergreen, linear. Flowers yellowish. Trees natives of Europe, Asia, and North America, generally in regions more temperate than those in which the species of spruce abound. Remarkable for the regularity and symmetry of their pyramidal heads; readily distinguished from the genus Abies by their leaves being more decidedly in two rows; by their cones being upright, and having the scales deciduous, and by the seeds being irregular in form. The nucleus of the seed is exposed at the inner angle, through a considerable opening in the outer testa, as if the junction of the two sides had been ruptured by the rapid enlargement of the nucleus. (D. Don.)"

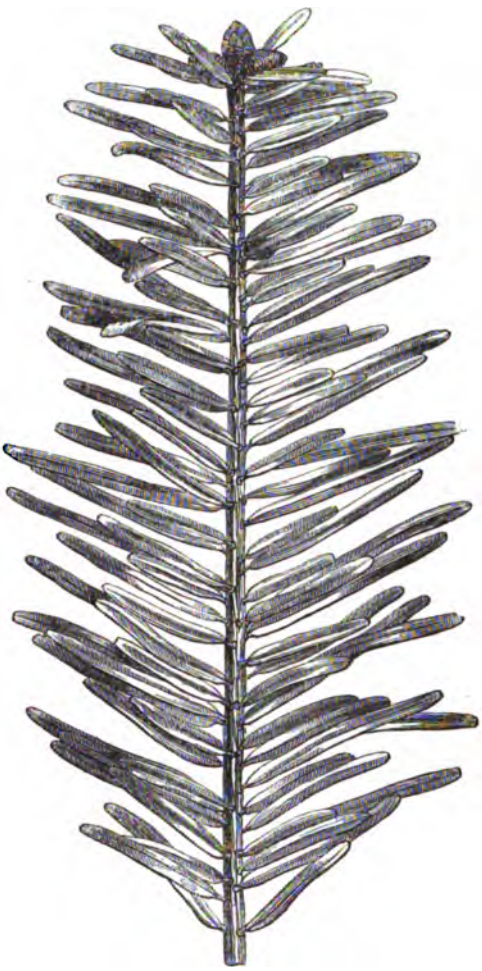
652. There are several species of this genus recently introduced into this country, some of them seemingly hardy enough to stand our climate generally; but as I have not as yet had sufficient experience of their culture to enable me to speak decidedly, I decline for the present to give my opinion in reference to them, and therefore shall refer only to the common Silver Fir.

SECTION XXXIX.—THE COMMON SILVER FIR.

653. The common Silver Fir (P. Pectinata) is thus specifically described in the *Arbor. Britan.*:—"Leaves solitary, flat, obtuse, two-ranked, with their points turned up. Cones axillary, cylindrical, erect; scales with a long dorsal bractea. Anthers with a short crest, with two teeth. Buds short, egg-shaped, blunt (see Fig. 114); of a reddish yellow, with from 16 to 20 blunt scales. Leaves from ½ inch to 1 inch long (see Fig. 114), stiff, turned up at the points, of a shining dark green above, and with two lines of silvery white on each side of the midrib beneath. Cones from 6

inches to 8 inches long, and from 1½ to 2 inches broad; cylindrical, green when young, afterwards reddish, and when ripe brown. Scale ⅙ inch to 1¼ inch long, and 1¼ inch broad. Seeds variously angular, ⅜ inch long, and 3/16 inch broad. Cotyledons 5. A lofty tree. Central Europe, and the west and north of Asia; rising on mountains to the commencement of the zone of the Scots Pine. Height 80 to 100 feet, rarely 150 feet. Introduced in 1603. The blossoms appear in May, and the cones are matured in the October of the following year."

Fig. 114.



654. This is a truly noble and interesting tree, and by far too little cultivated in our home plantations. At a distance this tree has very much the appearance of the spruce fir; but upon a nearer inspection, the leaves are found more decidedly in two rows upon the branches, and silvery underneath. The cones are also placed upright upon the branches; whereas upon the spruce fir they hang downwards. It is also not so soft and pliable in its appearance, the branches having a more rigid aspect, and being generally much stronger than those of the spruce fir. The silver fir rises to a great height, carrying with it at the same time a proportional girth. There is one standing upon the lawn behind Arniston House, a hundred and ten feet high, with a bole nearly twelve feet in circumference near the ground. This is a very fine specimen of the genus, and contains about two hundred cubic feet of timber. On the pleasure-grounds about Hopetoun House, the seat of the Earl of Hopetoun, near Edinburgh, there are several specimens of this tree, apparently as large as the one I have mentioned above; showing the great dimensions it attains under favourable circumstances.

655. Were the silver fir more generally introduced into our plantations, it would become a favourite tree, it being more hardy than the spruce fir with us, and adapted to grow upon a drier soil. In situations twelve hundred feet above the level of the sea, I have seen the silver fir growing rapidly, and promising fair, and that too upon a dry gravelly soil of very inferior quality. The wood of this tree is generally reckoned of better quality than that of the spruce fir; at least when it has arrived at maturity. When young, it is rather short-grained, and does not last long when exposed to the changes of our climate; but if the wood be at or about fifty years of age, I consider it preferable to the spruce, and capable of being used for all purposes for which that wood is in demand.

656. This tree is propagated from the seeds in the same manner as has already been recommended for the spruce fir. The cones are generally ripe about the end of October, and the seeds are separated from the cones by the heat of the sun in dry airy days. It should be sown in the month of March upon beds rather thinly, as the young plants when they come up are rather spreading in their habit. The plants should remain two years in the seed-bed, when they may be planted out into nursery-rows, rather thinly also, as they are when young of a bushy nature, and do not agree with confinement. They are also of slow growth when in their young state, and will require three years in the rows before transplanting into the forest ground.

657. The silver fir thrives best upon a sandy loam; at least I have seen by far the finest specimens of this tree upon such a soil. However, from having seen them of excellent and vigorous growth in very stiff clay soils, as well as upon soils of an opposite nature, I am inclined to think that the tree is by no means particular as regards the quality of soil; but it makes its most healthy development on a good sandy loam upon a dry bottom. I have planted a considerable number of silver firs of late, being desirous to have it more extensively introduced than it has yet been.

SECTION XL.—THE LARCH.

658. The Larch (*Larix*) is also a genus of the natural order CONIFERÆ, and the Linn. *Monœcia Monadelphia*, and is thus described in the work formerly referred to:—"The character of the genus is same as in *Abies*, but with the cones ovate-conical, erect, and the carpels and bracteas adherent to the axis. Leaves annual, and disposed in groups. Leaves simple, in alternate fascicles, exstipulate, deciduous, linear. Flowers reddish or yellowish. Trees deciduous, some of them of large dimensions; natives of the mountainous

regions of Europe, the west of Asia, and of North America; highly valued for the great durability of their timber. The common larch is found extensively in the Alpine districts of the south of Germany, Switzerland, Sardinia, and Italy; but not on the Pyrenees, nor in Spain. The Russian larch (*L. e. Sibírica*), is found throughout the greater part of Russia and Siberia, where it forms a tree generally inferior in size to *L. Europœa*. The black, or weeping larch (*L. Americana pendula*), is a slender tree, found in the central districts of the United States; and the red larch (*L. Americana rubra*), also a slender tree, is found in Lower Canada and Labrador. In Britain all the species are ornamental, but the first is the only one at all deserving of culture as a timber tree."

659. I quite agree with this statement of Mr Loudon, in respect to the larch, viz., that only the European species is worthy of cultivation as a timber tree in this country, and I propose, therefore, to confine my remarks to it.

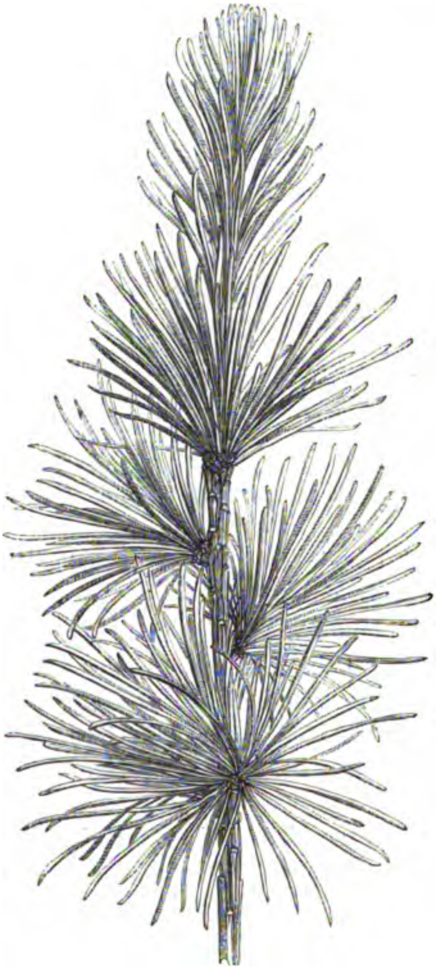
SECTION XLI.—THE EUROPEAN OR COMMON LARCH.

660. The common European Larch (*Larix Europœa*) is thus botanically described:—"Leaves fascicled, deciduous (see Fig. 115). Cones ovate-oblong; scales reflexed at the margin, lacerate; bracteoles panduriform. Leaves linear, soft, 1 inch long. Cone from 1 inch to 1¼ inch long, erect. A tall, pyramidal, deciduous tree. Alps of the south of Europe. Height 80 feet to 100 feet. In cultivation in Britain since 1629. Flowering in March and April, and ripening its cones in the autumn of the same year."

661. There is one feature in this tree which distinguishes it from others of the coniferous tribes—namely, its shedding its leaves in the autumn of the same year in which they are produced. It is decidedly one of the most valuable of the coniferous trees yet introduced into this country, both in respect of the quick progress which it makes, and of the real value of its timber. Being a native of the mountainous districts of Germany, it is found to endure the climate of the north of England and the mountainous tracts in Scotland as well as the Scots pine; but it is more particular with regard to the circumstances which favour its healthy growth than that tree. As an instance of the success of the cultivation of the larch in Scotland, may be taken the plantations of the Duke of Athol in Perthshire, which far surpass any others in Britain, as regards both their magnitude and quality of timber. Upon the Arniston grounds I have cut down several very old larches, one of which, in particular, when lying prostrate

upon the ground, measured, from bottom to top, ninety feet. There are others one hundred feet in height; and one tree yet growing upon the lawn contains about two hundred cubic feet of timber, and is apparently quite sound.

FIG. 115.



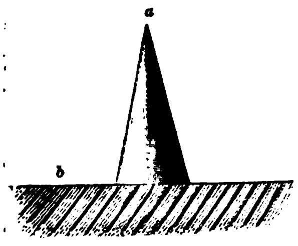
662. There are two varieties of the larch generally found in cultivation in the plantations in Scotland—namely, the white-wooded and the red-wooded. The white is the variety which attains the greatest dimensions of timber, and is the sort most generally cultivated, although they are both often seen growing together in the same plantation, and that by mere accident. It is said that upon the Athol estates the red larch does not attain to more than one-third the cubic contents which the white larch does; and this is observable in every plantation where the two varieties are found growing together.

663. As to the durability of the larch wood, it is allowed by all who are at all acquainted with the tree, and who have had occasion to use the timber, to be decidedly the toughest and most lasting of all the coniferous tribe we are yet acquainted with. There is also a peculiar feature characterising the wood—namely, its being durable and tough when only of a few years' growth. Of this I have had ample proof from my own experience in erecting fences with young larches. As the general result of my experience in erecting fences with the various sorts of pine and fir-wood, I may state, that when I put up a larch paling with wood from fifteen to thirty years old, I reckon that it should last from fifteen to twenty years; if of spruce fir, from seven to nine years; if of Scots pine, from four to six years. These remarks, however, only refer to the wood forming the rails

of a paling, not to the posts which go into the ground. These do not last so long, as will be seen from the following estimates. If larch posts are used, I expect they will last from eight to ten years in a fair state; if spruce fir, from four to five years; and if of Scots pine, from three to four years. Again, in putting up gate posts made of wood from thirty to forty years old, larch-wood being used, I expect them to keep good from fifteen to twenty years; if spruce fir, from eight to ten years; and if Scots pine, from five to eight years: the difference of time in the above cases depending upon the quality of the wood and the nature of the soil in which it is placed. In extreme cases of durability in the larch which have come under my notice, I have seen the upright spars, as well as the horizontal bars, of larch palings, standing quite good at thirty years of age. These were made from old wood of a matured quality; this indicating that there is ultimately a saving to the proprietor who makes his fences with good old wood. As, however, the young wood is generally cut down in the way of thinning the plantations, it is necessary and proper to use it, seeing a much higher price can be got for the matured wood for in-door and other purposes. Upon the estate of Arniston we made all our field-gates from our own home-grown larch; and when painted, they lasted for a great number of years, being more durable in this respect than those made from the best foreign timber; while for general use in all country purposes, no wood is more in demand than the larch. For roofing I sell a great deal of it; also for boards adapted for all purposes, sleepers for railways, &c., and for palings of all descriptions. A great quantity of young larch is now used for coal-pit purposes, or what is generally termed *prop-wood.* There is no description of larch-wood which I have more demand for than the young thinnings, from ten to twenty years old, being from two to five inches in diameter. These are greatly in demand for fancy or rustic palings; and although we have a great extent of young larch thinnings cut every year, we are never able to supply even one half the demand for trees of that size—which shows how much this wood is in repute for fencing alone. This demand is occasioned by the wood of that size being more durable than any other small wood of the same age. In England, large numbers of young larches are raised for hop poles, for which purpose no wood can answer better, both as regards its tall elastic nature and its durability. Full-grown larch timber is now much used for different purposes in ship-building. Of late, many vessels of considerable size have been built almost entirely of this wood. In short, the wood of the larch is daily coming the more into repute the more its properties are becoming known; and I believe that, ere long, it will to a great extent supersede all other trees of the coniferous tribe, if not in a great measure the generality of our hardwood trees also, in consequence at once of its rapid growth and of the great durability of its timber, more particularly when allowed to arrive at full age.

664. The larch is propagated from seed in the same manner as the Scots pine, and the observations stated with regard to that tree are equally applicable in the case of the larch. One point of difference relative to the larch, however, is, there is considerable difficulty in getting the seeds disengaged from the cones. Some people kiln-dry them in order to open the scales of the cones; but, as I have formerly said, this operation is dangerous, and cannot be recommended. The following is the way in which I have extracted the seeds from the larch cones. Having the cones collected in a dry loft, I set a few boys to pare the base of each cone *close* with a sharp knife, just so far in as to make the end of the little central pillar appear distinctly and level. After they are thus prepared, I have a few more boys, or it may be women, each with an instrument as shown in Fig. 116, consisting of a pointed cone-shaped piece of iron *a*, the exact size in the engraving as used, fixed into a small block of wood *b*. This instrument when at work lies upon the floor; and by placing the pared base of the pillar of the larch cone right upon the point at *a*, and giving the top of the cone a few gentle strokes with a very small mell, or other piece of wood, it is split up at least into two halves. These being laid to one side as they are split, another party with a sharp knife each, can subdivide them again, making each cone at least into four parts; and in this manner a few women and boys will in the course of one day open up a great quantity. The cones being thus opened up by the use of the instrument and the knife, they should in this state be exposed on sheets to the influence of the sun every day, when they will soon part with their seeds on a gentle thrashing with a small flail.

FIG. 116.



665. The seed should be stored past in a cool place till the beginning of April, when it should be sown exactly in the same manner as has already been advised for the Scots pine. The young plants should remain only one year in the seed beds, when they are termed *one-year seedlings.* Some nurserymen are in the habit of allowing them to remain two years in the seed beds; but I condemn this mode as injurious to the healthy development of the future trees, and recommend that they should only remain one year, as such plants succeed most healthily after having stood in the nursery grounds in rows for one or two years. In collecting the seed of the larch, great care should be taken not to gather it from diseased trees; nor should it be gathered

from trees of a small size; for the very fact of small larch trees having seed upon them, is enough to point out that they are not of sound constitution. The seed of the larch, as well as of all other trees, should be gathered from trees of large size, and known to be sound. Were this point more attended to, that disease in the larch termed the rot might in a great measure be in future prevented; for it is well known that, if the parent be diseased, the seed of that parent will be in a degree diseased also. Moreover, as the most diseased trees generally bear the greatest quantity of seed, the seed-gatherers, who collect it for nurserymen by the bushel, will be most ready to take it where it is most plenty, and will of course pay them best. In order to prevent this, nurserymen ought to give a fair salary to a man in whom they can place confidence, who should superintend the gathering of all their larch seed; and he should at the same time be a man who is likely to know a healthy tree from an unhealthy one.

666. The quality of the wood of the larch is, as well as that of most other trees, much affected by the nature of the soil and situation upon which it is grown. I have paid some attention to this point, and find that larch trees growing upon a rich loamy soil, and in a rather sheltered site, do not produce nearly such durable timber as trees grown in a more exposed site and upon a poorer soil. In cutting up wood at our saw-mill, I have often observed that, in the case of larch, which has grown upon a rather rich soil and in a sheltered site, the saws go through it easily and without heating; an evident proof of the softness of the wood. On the other hand, in larch-wood which has grown upon a poor or rocky situation, having a free exposure, the saws go through it with difficulty; and this I consider an evident proof of the hardness and durability of the wood. Our best and healthiest larch-wood is generally found growing upon decayed rock, or what may be termed *stone rubbish.*

667. The larch is, from its upright habit, one of the very best nurses we have for hard-wood trees. It does not, indeed, produce so much warmth to young hard-wood trees in the spring and winter season as the pines or the spruce fir do; but notwithstanding this, where there is a mixture of larch among young hardwoods, these are generally in better keeping than when over-nursed by the Scots pine and spruce fir.

668. The circumstances which I have found most favourable to the healthy development of the larch are—as to soil, it is not particular, but the roots must be in a soil which has been well cleansed by the free passage of water through it, and which has, at the same time, the benefit of being constantly kept clean and in a pure state by a good descent for the water that may fall upon it, either naturally or by means of well-made drains, as

is particularly exemplified in the case of larches growing on all mountain slopes, where there is a continual descent of water from the higher to the lower grounds. In the cultivated forest, this can be imitated by good deep drainage.

SECTION XLII.—THE CEDAR.

669. The cedar (*Cedrus*) belongs also to the natural order CONIFERÆ, and in the Linn. system to *Monœcia Monadelphia.* The character of the genus is thus given in the *Arbor. Britan.*: "The same as in Larix, but with the carpels separating from the axis, and the leaves evergreen. Cones erect, large, solitary. Anthers crowned by an elliptical scabrous crest. Carpels coriaceous, compressed, deciduous. Leaves simple, in alternate fascicles, exstipulate, evergreen, linear. Flowers yellowish, powdery. Trees majestic in form, and evergreen; natives of Asia and Africa, with large spreading branches. Extremely ornamental, and one species producing excellent timber."

670. As there are only three species of this genus introduced into Britain—namely, the Cedar of Lebanon, the Indian Cedar, and the African Cedar, I shall refer to each of them, as they are ornamental in the highest degree, hardy, and easy of cultivation, and the timber of the Indian cedar is said to be of the most durable description, and highly valued in this respect by the inhabitants of that part of India from which it has been introduced.

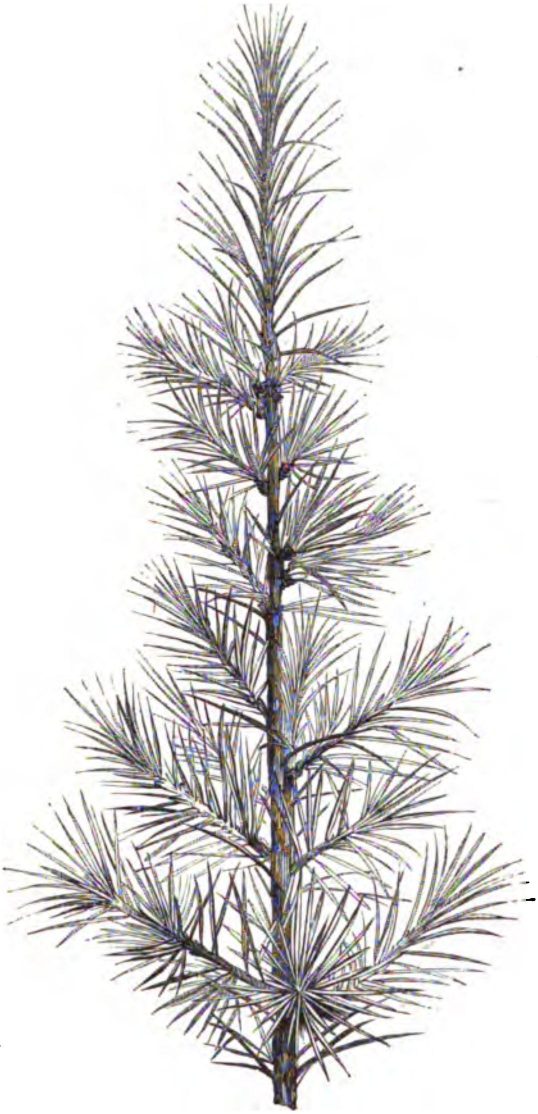
SECTION XLIII.—THE CEDAR OF LEBANON.

671. The specific character of the cedar of Lebanon (*Cedrus Libani*), is thus stated in the *Arbor. Britan.*: "Leaves tufted, perennial (see Fig. 117). Cones ovate, abrupt, their scales close-pressed. Crest of the anthers ovate, flat, erect. Cones ovate, from 3 in. to 5 in. long, and from 2 in. to 2½ in. broad. Seeds of an irregular triangular form; nearly ½ inch long, with a very broad membranaceous wing. Cotyledons 6. A large, spreading, evergreen tree; Syria, on Mount Lebanon, and the north of Africa on Mount Atlas. Height 50 feet to 80 feet. Introduced before 1683. Flowers yellow, May. Cones purplish-brown, ripening in the autumn of the third year, and remaining on the tree for several years."

672. Were I asked the question, which is the tree suited to produce the grandest effect on a home park? I should reply, undoubtedly the cedar of Lebanon. There is no other tree that I am acquainted with that has stamped on it so decidedly an expression of

majesty and grandeur. The oak is certainly a noble and admirable tree in its general outline and bearing; the pine, and the larch, and the fir, are tall and stately specimens of the vegetable kingdom; but when these are compared with the broad massive exhibition of branches, and grand expression of a full and well-grown cedar of Lebanon, they seem tame, and lose in our eyes even the effect they had before comparison. In short, as an ornamental tree, this is, in my opinion, superior and preferable to all others we have in this country.

FIG. 117.



673. From the grandness of the effect of this tree I am surprised that we do not find it more cultivated in this country than it is, as there are comparatively few places in which we find it of any size, and in which it has been done justice to as an ornamental tree. In many localities, indeed, it is to be found growing in shrubberies, encumbered with all sorts of rubbishy and drawn-up evergreens, where it stood with a clean, drawn-up, pine-like stem, and with a bushy head, more resembling a stunted Scots pine than the cedar, altogether out of place and out of character; but on few places have I seen the tree occupying the position it deservedly is

entitled to, or managed in such a way as to render the specimen characteristic of its genus.

674. On the home park of Hopetoun House, in West Lothian, there are a few very fine specimens of this tree. They have been very judiciously planted at considerable distances apart from each other, and from any other trees, and the result is, that they have had ample room for the full development of their branches, and that they have become gigantic vegetable pyramids, giving a character to the neighbourhood of the park on which they stand that no other tree could possibly give. At Arniston there are several specimens of this tree, two of which are especially good. The stem of one of these, which stands near the mansion-house, is, I should say—I speak from memory only—four feet in diameter, and the spread of the branches somewhere about sixty feet in diameter.

675. Ornamental as this tree is, however, it is not at all adapted for a useful timber tree as grown in our climate; and to show the estimation in which it is held in this respect by dealers in timber, I may mention, that some years ago, when I had to do with the Marquess of Abercorn's woods at Duddingston House, near Edinburgh, we had a pretty large and matured one cut down, as it interfered with a very valuable and thriving oak. It was sold along with other thinnings from the home park, and when put up for sale, although its kind was explained to the purchasers when bidding for it, and although there were all sorts of dealers in wood present, it was knocked down at about 10d. per foot—less than was got at the same time for Scots pine. This shows the estimation in which the timber of the *C. Libani* is held; and I mention the circumstance to show that, as a timber tree in this country, it stands at the bottom of the list of the coniferæ, and should therefore not be planted with a view to profit, but for ornamental purposes alone.

676. When we consider the very high estimation in which this tree was held by the ancients, and how durable the timber of it is when grown on its native mountains, especially in Asia, we are surprised that it should be so worthless when grown in this country. There can be no doubt that the difference of soil and climate affects the timber of the tree in this respect; and it is but reasonable to suppose that this should be the case, as in this country we have the degrees neither of cold nor of heat to which it is accustomed in its native habitat in Asia. In short, with respect to this tree, it is, in my opinion, of all others the best adapted to be grown for magnificent effect, but nearly the worst that can be raised for timber.

677. It is propagated from seed, which is sometimes imported from the

Levant, and sometimes procured from cones grown in this country. When the cones are matured—and it must be borne in mind that they do not ripen till the end of the third year—they should be collected and laid past in a dry airy loft for one year, when the seeds will be easily extracted from them, from the dryness and openness of the scales. They should afterwards be sown, say in the month of March, in boxes of any convenient length and breadth, and of 6 inches in depth, in order to facilitate their growth and their transplantation with all their roots afterwards. The seeds will germinate and grow rapidly about six weeks after they are sown, and when the plants are one year old they are generally planted out into small pots, and shifted into larger ones till they are of sufficient size to go out to their destinations, which is generally when they are four or five years old. In thus cultivating them in pots, the pots should be plunged into the earth, in order to keep the roots cool and from drought. Many prefer to sow the seeds in beds as the common pine is sown, and to transplant the seedlings out into lines in the same way as these are generally dealt with. I believe, however, that the former mode is the better of the two, as by it the young plants are more likely to be taken care of, and to suffer less damage in their roots when planted out.

678. The *C. Libani* is a tree by no means particular in regard to soil, provided always that it is dry and of an open and porous bottom. In short, it will grow well in any soil suitable for the larch, and it is in every respect as hardy as that tree is.

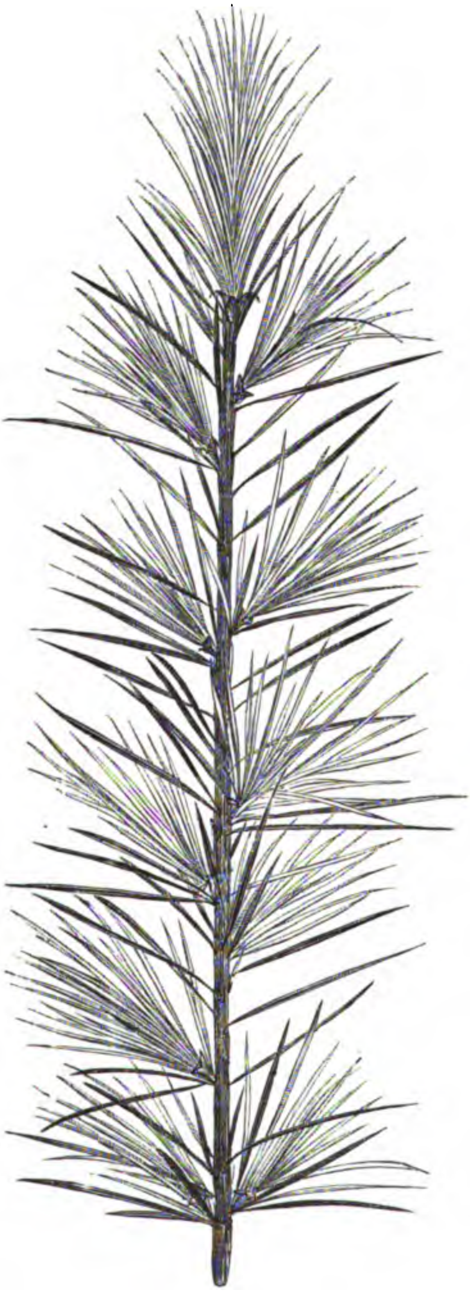
SECTION XLIV.—THE INDIAN CEDAR.

679. The specific character of the Indian cedar (*Cedrus Deodara*) is thus stated in the *Arbor. Britan.*: "Leaves fascicled, evergreen, acute, triquetrous, rigid (see Fig. 118). Cones twin, oval, obtuse, erect; scales adpressed (Lamb). Cones from 4¼ inches to 5 inches long, and from 3½ inches to 3¾ inches broad. Seed, with the wing, nearly 1½ inch long; scale about the same length, and 2 inches broad. A large evergreen tree; Nepal and Indo-Tataric mountains, at 10,000 or 12,000 feet above the level of the sea. Height 50 feet to 100 feet, rarely 150 feet. Introduced in 1822, and apparently as hardy as the cedar of Lebanon, from which it is readily distinguished at a distance by its general aspect being comparatively whiter."

680. This tree is readily known from the cedar of Lebanon by its

drooping habit of branches, and by its lighter appearance. The cedar of Lebanon has a dark-green aspect, and is strong, firm, and horizontal in the spread of its branches, while the Indian cedar has an appearance quite the opposite of this, and besides, is at all stages of its growth a more free grower, and from my own experience, I should say is even a hardier tree.

FIG. 118.



681. Judging from the young specimens we have of this tree in this country, it is perhaps as ornamental in its habit of growth, and in the display of its branches, as the cedar of Lebanon is, but perhaps not so imposing and grand. The weeping habit of its branches gives the tree a more graceful aspect than the other, but this detracts from it in point of grandeur and majestic effect. Still, we can only judge from the tree as we have it here in its young and comparatively undeveloped stage. Travellers who have seen it full grown in its native mountains, all agree that it is a tree of extraordinary, majestic, and imposing effect, and that it unites these qualities with beauty and gracefulness. All this I am quite prepared to accept, as even in the young state, say in trees of from twenty-five to thirty years old, it is, like its sister cedar, a tree not surpassed by any in an ornamental point of view.

682. But besides this quality, it is said to be highly valued for its timber by the inhabitants of the country from which it comes. I have myself seen a large plank which was taken from a full-grown tree in India, and certainly, judging of it from this specimen which I saw in the Office of Woods and Forests in London, I should say that the timber is of first-rate texture, and deserving of the character it has got in its native country. But whether grown in this country, even when it shall arrive at maturity, it will produce timber equally or nearly as good, remains to be seen; and ere we can know this many years will have to elapse. One thing I am convinced of, however, in regard to it, that it is a hardy, rapid growing tree, and therefore seemingly worthy of cultivation under all reasonable circumstances.

683. I have now cultivated this tree to some extent, even as far north as Strathspey, and even here we find it quite hardy, and by no means particular as regards soil, as I have it making fair progress on poor gravelly knolls on which only the pinus sylvestris itself will succeed satisfactorily. All this comes in to prove that the tree is well adapted to grow even in the poor lands of the Highlands of Scotland, and that it is likely ere long to become not only more and more an object of ornament, but also one of profit in point of its timber.

684. To grow this tree well for timber, however, as it is while young very much disposed to throw out strong side branches, I would suggest that it should be planted at twenty feet apart, and intermixed with larch to five feet apart over all the ground occupied by it. In this way plantations of it should be made, on the same principle as we at present rear oak trees among larch nurses, with a view to their becoming timber. This seems to me the most sensible mode of dealing with the tree in order to its becoming profitable as timber, as the larch nurses will have the effect of checking the over luxuriant growth of the side branches, as well as of sheltering the trees and causing them to grow rapidly upwards.

685. As the plants of this species are now becoming comparatively cheap—one shilling each from six to nine inches high—I contemplate next year to plant an inclosure of some fifty acres in the way described in the foregoing paragraph, as I have no doubt that they will succeed well when planted among larch nurses on a fair soil even in Strathspey.

686. Some five or six years ago, while engaged in surveying the government forests in England, I saw a large quantity of the seed of this tree—I think one ton weight of it—in London, which had been collected by the India government in order to be reared in this country and planted in our

forests; but whether the parties in charge have managed to grow it satisfactorily, and whether they have planted out the young trees raised from that supply, I am not prepared to say. I hope that they have, and that they have been able to set an example to the landed proprietors of both England and Scotland in this respect, by the success of the mode they have adopted in rearing a tree in all probability destined to become a very valuable addition to our forests.

687. This tree is in most cases reared from seeds, which are now abundantly imported, but is also still, in some cases, reared from cuttings, and by engrafting on the common cedar. Plants, however, reared in any way other than from seeds should be objected to by the purchaser, as it is very doubtful whether those reared by cuttings, or by engrafting on other sorts, will ever make either such fine specimens, or such good timber trees as those reared in the natural way from seeds. I think it proper to make this remark in order to put purchasers on their guard when buying them from public nurserymen.

688. I have raised a considerable number of this tree from imported seed, and have found it succeed admirably, treated in the same way as is described in regard to the rearing of the cedar of Lebanon. I have one other remark to make on this point, however, and that is—that when the seed is imported after being extracted from the cones, a large proportion of it is very apt to lose its vitality, so that I would suggest that parties ordering the seed from their friends in India should either direct it to be sent *in the cones*, or if otherwise, at such a time as that it may arrive here in the spring of the year, when it can be sown immediately, and thereby secure its vitality being preserved.

689. I have already hinted that this tree is by no means particular in regard to soil; I must, however, qualify this statement by stating that, in making plantations of it for some years to come, it will be well to plant it only on as favourable spots as can conveniently be set apart for it, in order to give it every chance of succeeding until we shall be better acquainted with its habits than we yet are. With this end in view I should say that a light loam, rather deep than otherwise, and by all means dry in the subsoil, should be the land to plant it on, in order to give it every chance of success.

690. I have said that there is a strong tendency in this tree to throw out strong side branches while young, and that this tendency has the effect of retarding the upward progress of the plants. In order to check this disposition, we are in the habit of *pinching in the side shoots* in the month of May, just when the trees begin to grow, which has the effect of checking the growth of the branches, and of causing the sap to be thrown more into

the stem than it would otherwise be. We do not cut off the branches, but merely remove from two to three inches from the points of the strongest side shoots, and we find this have a very good effect on the after growth and form of the plants.

SECTION XLV.—THE MOUNT ATLAS CEDAR.

691. The specific character of this tree (*Cedrus Atlantica*) is thus given in Gordon's *Pinetum:* "*Leaves*, in tufts, or singly on the young shoots, stiff, needle-shaped, cylindrical, or flattened on the upper side, sharp-pointed and straight; evergreen, with a silvery appearance, and shorter and denser than those of the common cedar of Lebanon, very irregular in length in the fascicles, varying from ½ to ¾ inch in length, longer on the leading shoots, and with a furrow running along the whole length of the leaf. *Branches*, rather slender, less rigid, and covered with scattered bundles of leaves, mostly opposite, but sometimes irregularly placed. *Cones*, ovate, flattened, or rather depressed at the ends, from 2½ to 3 inches long, erect on the upper side of the external branches, of a shining light brown colour, and full of resinous matter. *Scales*, flat, closely pressing against each other, smooth, broad, truncate and blunt on the upper part, of a leathery texture, and thin on the edges. *Seeds*, of an irregular or angular shape, soft, and with a thin transparent ring, one inch or more long. A noble tree, like the cedar of Lebanon, growing from eighty to a hundred feet high, with horizontal branches, and a tabular-shaped head, but rather open in appearance. It is found on the highest mountains in Barbary, particularly on the famous Atlas range in Northern Africa, at an elevation of from seven thousand to nine thousand feet, in great abundance, and is quite hardy, and more rapid in growth than the common cedar."

692. It is readily known from the cedar of Lebanon by its more upright and free habit of growth, and from the Indian cedar by its never assuming the peculiar pendulous habit which that tree does. In the young state, however, it very much resembles the cedar of Lebanon, and by the inexperienced eye may readily be mistaken for it; but the more upright and free-growing habit at once distinguishes it. Comparing the cedar of Lebanon with it, say in the case of young plants of some five years old, the average height of the former may not exceed eighteen inches, while that of the latter will be at least thirty inches.

693. The tree seems as hardy as the Indian cedar, as we have it even in Strathspey seemingly as free-growing as that tree. It seems to have

a strong tendency, however, to die off suddenly when planted on a wet subsoil, and this is a point in the growing of the tree which should be particularly guarded against. No doubt the most of the pine family are impatient of wetness in the subsoil, but the cedar under notice is more so than any other. In planting this tree, therefore, great attention should be paid to see that the subsoil is perfectly dry, either naturally or made so artificially.

SECTION XLVI.—THE ARAUCARIA.

694. The ARAUCARIA, which is a very remarkable genus of tree, has its character thus described in the *Arbor. Brit.*:—" *Male flower*, with the pollen contained in from 10 to 20 cases, pendent from the apex of the scale. *Ovule*, solitary, connate with the carpel or scale. *Leaves*, simple, alternate, exstipulate, evergreen, imbricate. Trees of magnificent dimensions, and evergreen; natives of South America, Polynesia, and Australia; only one of which, the ARAUCARIA IMBRICATA, is hardy in the climate of Britain."

As stated above, only one species of this genus is hardy enough to stand the climate of Britain; I shall therefore proceed to refer to this species.

SECTION XLVII.—THE ARAUCARIA IMBRICATA.

695. The specific character of this tree is as follows:—"Leaves in eights, imbricated, ovate-lanceolate, with persistent mucros (*Pav.*) (see Fig. 119). An evergreen tree. Cordilleras, in Chili. Height, 50 feet to 100 feet, rarely 150 feet. Introduced in 1796, and flowering from September to November."

696. The appearance of this tree is altogether foreign, and quite different from any other we have had introduced into this country, hardy enough to stand and prosper in its climate. The stem is in all cases perfectly straight, and, while young, it is covered with its hard and sharp-pointed leaves from bottom to top, while the branches project horizontally in whorles of 6 or 7, at pretty regular distances apart.

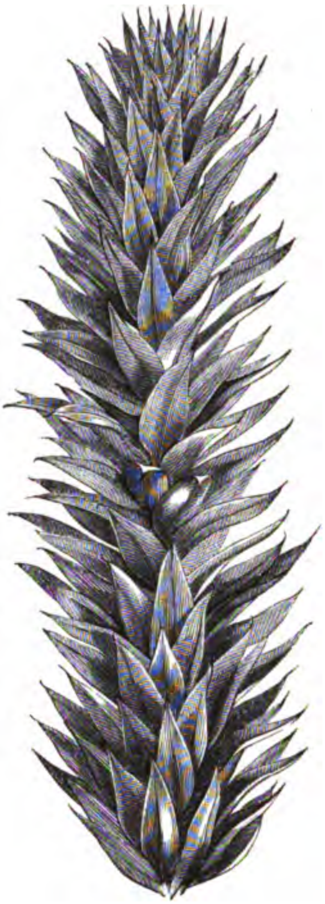
697. I have planted this tree pretty extensively, and find it perfectly hardy even in the climate of Strathspey. I cannot account for the cause, but I state the fact, that, in some years, it is found to make shoots of from 10 to 15 inches, while in other seasons it will make no apparent progress at all; and I have observed the same peculiarity of this species

in trees growing in all parts of the country. The strongest and handsomest specimen that I have seen was at Dropmore, in England. I saw it in the year 1851, and it was then about 30 feet high, with a stem about 9 inches diameter 5 feet from the ground. It was a noble-looking tree, and highly singular in appearance, but at the same time highly ornamental, in its contrast with many other species of the coniferæ growing in its neighbourhood.

698. I am not of opinion that this tree will ever become generally useful as timber in this country; from the slowness of its growth, and from its requiring rather a rich soil and sheltered site to force it to grow at all satisfactorily, it must be kept merely as an ornamental specimen. Such, at least, is my opinion of it under our present knowledge of its habits and peculiarities.

699. Abundance of seed is now imported; these are sown in boxes, and dealt with as I have described in regard to the rearing of the cedar; but as the seeds are large they require to be covered nearly an inch in the earth. Plants about 8 inches in height are sold at 3s. 6d. each.

FIG. 119.



SECTION XLVIII.—GENERAL REMARKS IN REFERENCE TO THE FOREGOING SECTIONS DESCRIPTIVE OF FOREST TREES.

700. Having now briefly stated the peculiarities of each sort of forest tree which is generally cultivated in our plantations for the sake of timber, as well as given my opinion in regard to such of the lately introduced species as I consider hardy enough for growing profitably in our climate, I may add further, that all deciduous hardwood trees, to grow them properly, require more shelter than firs or pines do; consequently, in all cases of planting a piece of land, the hardwood ought to be planted upon the most sheltered parts, always keeping the firs and pines upon the high and

exposed districts. This is only imitating the proceedings of nature in the same operation; for, in the natural disposition of trees over the surface of the earth, the firs and pines inhabit those cold, high-lying districts where the soil is thin; and the oak, ash, elm, &c., the more temperate regions nearer the equator. The hardwood trees, to grow them well, require a heavier and a richer soil than the coniferæ do; which suggests to us that in laying out a new plantation the hardwood should be planted in the heaviest and richest parts of the soil contained in it.

701. The planter being possessed of a knowledge of the soil and situation adapted to the healthy growth of each species of forest tree, his duty is, in the planting of a piece of land with forest trees, to use those sorts which, from his knowledge, he has reason to expect will succeed upon it. With this view he may proceed thus:—Let him examine the nature of the soil throughout the whole extent of the land designed for planting, and, having done so, consider what sort of tree will succeed best, for a permanent crop, upon each different soil and situation that may be embraced within the bounds of the intended plantation; and, having determined this point, let him proceed to have pits made for all hardwood trees intended to be put in—say at twelve feet distance from each other. Wherever the soil is found of a loamy nature, and the situation is not too high, plant oak, ash, elm, or plane-tree, at the distances specified; but in all cases giving the preference, in number and extent, to that species which is most likely to succeed best; and observing, in all cases where it is intended that one sort of hardwood alone shall be the ultimate crop, to plant no other hardwood among them. Thus, if you wish to have any particular part of a plantation to be entirely an oak forest ultimately, plant these in pits at twelve feet distance, and make up to the requisite thickness with coniferous sorts, generally Scots pine and larch, which are only intended to act as nurses to the hardwood, and to be cut down by degrees in order to give the latter room as they rise up and fill the ground. Where it is intended to have a mixed hardwood plantation, distribute the different sorts in accordance with taste, and make up to the desired distance, which in this case will be forty-eight inches, with pine or larch.

702. Having planted all the better parts of a plantation with hardwood, as above mentioned, if there be any poor heathy portions which would not raise such wood to advantage, occupy such entirely with coniferous sorts. In doing so, observe that if it be considered that larch-trees would grow to any useful size, but not so as to be relied upon for a crop upon the ground, then plant pines, say at eight feet apart, for a permanent standing crop, and make up to the desired thickness of about four feet with larch, which can be thinned out as the others require to have room.

In this manner the larch thinnings will come to pay well; for if the entire crop had been pines, little or nothing could have been got from them by the first thinnings—the larch being always valuable when young, while the pine is not so much so.

703. If, in planting a new plantation, there are found spots of ground lying very high, with an extremely thin, poor, sandy soil, upon which it is doubtful if even pines would attain a useful size, or live long as a permanent standing crop, plant there one half Scots pine, and the other half birch, of each an equal number per acre. By so doing, if the Scots pine happen not to succeed, as is very likely upon a high-lying sandy soil, then the birch are sure to keep the ground; and, although they may probably never come to be a valuable crop, still it is desirable to have a cover, though but for the sake of shelter, upon such portions of the land.

704. If, on the other hand, there are any low-lying, damp, swampy parts, make up these with alder, birch, and spruce fir,—giving the preference in number to that sort which may be considered most likely to succeed best as a permanent crop; and when they come the length of thinning, it can then be judged which sort will stand, and which should be taken away.

705. If there are any rugged precipices or steep glens within the bounds, plant larch and oak in the usual proportions; if it be considered necessary for the sake of shelter, plant a few Scots pines upon prominent points; and in any hollow parts of such grounds, put in poplars or willow-trees, or, if not too damp, spruce firs.

706. If the situation to be planted is near the sea, no plant, in the form of a forest tree, will succeed so well, as a nurse for others, as the PINASTER or cluster pine. Upon situations near the sea-coast, it is often difficult to get trees of any description to succeed to any considerable extent, even so as to make a moderate shelter; and it is in such situations that the pinaster is found useful. I have already described the operations of this kind on the estate of Dunskey, in Wigtonshire, where it was found impossible to grow almost anything like trees, until the pinaster was planted upon the heights along the sea-shore; and now, since these have risen up—and they grew very rapidly—the different sorts of common hardwood trees are thriving well behind them. In such a situation they do not, of course, rise up so as to make valuable timber themselves; yet as they grow very bushy, they form an excellent shelter for trees inland; and by the shelter attained from them, the more valuable trees behind succeed, which is the end in view in planting them.

SECTION XLIX.—AS TO HOW FAR THE VARIOUS SORTS OF CONIFERÆ INTRODUCED ARE LIKELY TO BECOME USEFUL IN THE CLIMATE OF GREAT BRITAIN.

707. I have already, in such of the foregoing sections of the chapter as have reference to the Pine, Fir, and Cedar tribes, stated my opinion at length in regard to such of them as I have found, from some years' experience, hardy enough for the climate of Great Britain; but as there are many other species that have been introduced into this country to which I have not referred at all, I shall say a few words on the subject of the newer species generally.

708. Of late years, a great number of different new coniferæ have been introduced into this country from Asia and the American Continent, and especially from the mountainous regions of California and Mexico; and some of these seem hardy enough to stand our climate, while others are evidently too tender to bear the winter, even in the most sheltered parts of our open grounds, without protection.

709. For the last fifteen years I have annually been in the habit of visiting the principal nursery establishments in the neighbourhood of Edinburgh, in order to purchase such of the newer sorts of coniferæ as I think likely to become useful in our plantations, whether as timber or as ornamental specimens only; these I have had planted out, either in some one of the young plantations we were engaged in planting at the time, or on some part of the home grounds, if it seemed that shelter was necessary for some particular species. The result of my experience on the subject of these newer species is, my recommendation of those which I have found quite hardy, as detailed in such of the foregoing sections of this chapter as refer to the coniferous species.

710. I am aware that, besides the sorts which I have recommended, there are others which at present may be said to be hardy enough to grow on the lower-lying and sheltered parts of estates in the south; but as I wish to test such sorts still further than has yet been done in the south, by planting them out in the young woods in the Highlands of Scotland, I postpone giving an opinion on them till they shall have been subjected to the test of further experience. In the mean time, however, I may state, in a general way, that there are, in my opinion, some other eight or ten sorts which will be found hardy enough to grow, as timber trees, in any plantation of moderate elevation in Britain, provided that they shall be properly dealt with in regard to soil, site, and position among nurses while young.

711. It is well known that in some seasons many of the newer coniferæ will succeed well, and make wonderful progress, while in a succeeding one

they will appear sickly, and make scarcely any progress whatever. I conceive, therefore, that in giving an opinion on such a subject, a man should be well prepared to make good his statements, by showing the plants themselves in proof, and that no one can be said to have experimented properly on the rearing of such trees unless he have grown them on various soils and situations, and for a period of not less than ten or twelve years.

712. In short, of the forty species of pine and fir which I have experimented on, I think, at present, that nearly two-thirds will be found hardy enough, partly for hill planting and partly for ornamental purposes, on sheltered parts of home grounds, and that a third of them are too tender to stand the climate of Scotland during winter; some of them will stand better, however, the winter climate of the central and midland counties of England.

SECTION I.—THE PINETUM.

713. The pinetum means, in the general acceptation of the word, a piece of land set apart for the experimental cultivation of the newer sorts of coniferous trees.

714. Within the last twenty years many such have been made; and there are now very few landed properties of any very considerable extent on which there is not what is called one, whether it may be well got up or otherwise.

715. There are, however, few pinetums that have as yet been got up in this country on such sound principles as the nature of the object demands. The real object of a pinetum is to test the hardihood of the various species of introduced coniferæ, and their general adaptation to the climate and soil of the neighbourhood in which it is established. From what I have just said, it is to be inferred that the mode that has hitherto been generally adopted in planting pinetums in this country, does not seem to me satisfactory, and that I think there is room for improvement here. Instead, however, of pointing out what I consider the defects in the existing pinetums, I shall endeavour to show how an establishment of the kind should be dealt with, in order to answer the end in view, viz., that of growing the introduced species of coniferæ in such a way as most certainly to prove not only the hardihood of the subjects, but also that of their suitableness, whether for being planted in the forest, in order to their becoming profitable as timber, or on the park and pleasure-grounds, as ornamental specimens.

716. In laying off a piece of land for a pinetum, in whatever part of the country it may be proposed to establish it, it should be on a high-lying and rather exposed site, and certainly never on a low-lying and sheltered one; as on a site of the latter description it could only be a local thing, in which many species would thrive well in summer, and even survive the winter, that would merely exist in summer if planted on a site of the former character, and certainly die off altogether exposed to the winter of an elevated site, although this were comparatively moderate.

717. That species throve well in a pinetum established in the central and wooded plains of England, would be no proof that the same species would succeed, even moderately, on the bleak, high-lying slopes of the north of England and of the south of Scotland; neither would the fact of species growing well at an elevation of 1000 feet above the sea-level, on the latter parts, be any proof that these would prosper, even moderately, on the Grampian mountains, although planted there at a much lower elevation. And, besides this, there is the point of exposure to be taken into consideration, as we all know that, generally speaking, trees thrive differently—soil and elevation equal—according as they are exposed to the south, north, east, or west. In illustration of this point I may only refer to the fact that the larch never thrives so well on an east and south exposure as it does on one lying to the west or to the north. I cannot, indeed, say whether this is according to the experience of other foresters, but it is consistent with my own, even where I have found all other circumstances alike. From this, then, it is undoubtedly to be inferred, that the results of experiments in regard to pinetums, made on a south and east exposure, may be very different if conducted on land having an opposite exposure; and *vice versa*.

718. Any proprietor wishing to establish a pinetum on sound natural principles, and with a distinct view to ascertain not only the general hardihood of the species he may have in view to plant in it, but also to prove their suitableness for growing as timber in a close plantation, as well as their adaptation to ornamental purposes, and also to prove how far the different species are affected by the difference of elevation and that of aspect, should place it on a rounded hill, having an elevation, say of from 400 feet to 1000 feet, or upwards, above the level of the sea. Or, if he should not be so fortunate as to have the command of such a hill upon his property, he should endeavour to have several smaller pinetums established, say four, each at a different elevation, and having a different aspect.

719. In order to illustrate what I consider the proper way of going to work in the establishment of a pinetum, I shall suppose that a rounded hill is chosen—as such a site is certainly the best that can possibly be

selected for the purpose—and that the lowest part of it is 500 feet, and the highest 1200 feet, above the level of the sea. Such a hill may be enclosed to any convenient extent, say from 100 to 500 acres, according to circumstances, and according to the general formation of such elevations on a property. This being fixed upon, the land should, of course, be enclosed by a proper fence, and all wet portions of it drained, as in the case of enclosing and preparing for any other plantation.

720. The land enclosed, and in every respect prepared for planting, and supposing that there are 400 acres of it enclosed, I should recommend to proceed as follows :—

Having arranged that there shall be, say 100 different species and varieties of the newer sorts of pine, fir, picea, cedar, &c., to plant out in the proposed pinetum, and that they are to be planted at thirty feet apart, then this will give about 20,000 plants as the number required for the ground in all (400 acres); and if we suppose that an equal number of each of the 100 sorts is to be planted, then this will give 200 of each. The 20,000 young trees, consisting of 100 different sorts, being purchased, I should recommend that they be planted in regular parallel lines, from the bottom of the hill to its top, and at thirty feet apart every way all round, and that the sorts should be so intermixed in the lines, that there may be found, after the operation of planting shall have been completed, a fair proportion of each sort on the lower, the middle, and the higher parts of the hill, not only on one of its sides, but *on all its sides and aspects.*

721. The newer sorts of trees all put in as described, in the next place the whole ground should be planted up with larch and Scots pine nurses, say to the average distance of five feet apart over all; but in doing this, the larch and the Scots pine should be distributed over the ground in the following manner :—All along the lower parts of the hill larch alone should be planted; all along the middle parts an intermixture—say half-and-half —of the larch and Scots pine; and on the highest parts or portions, pine alone, on other portions larch alone, and on others an intermixture of both ; and these different classes of nurses should be made to spread over each different aspect, say on the summit, and on the east, north, west, and south sides.

722. From this mode of proceeding in regard to a pinetum, as soon as the nurses had attained some size, and it was found necessary to thin, this could be done in all sorts of ways; on some parts severely, in order to admit of the specimens developing their branches thoroughly, so as to show their natural habit; on others, the nurses might be more moderately removed, in order to prove the effects of a considerable degree of shelter on their habit and rate of growth; while on others they might be

left somewhat crowded, in order to prove whether they might make tall and straight trees for timber, if required for this purpose; and these different degrees of thinning might be applied on all parts of the enclosure, and on all the different species, without reserve. This, then, is, in my opinion, the only way of dealing reasonably and profitably in regard to a pinetum, as from it every proof that could possibly be desired could be found in regard to all the sorts; not only as the trees might be affected by elevation above the sea, but also as they might be affected by standing widely apart, by moderate thinning, and by thinning sparingly. In short, until we have a scheme of this kind wrought out in regard to the culture of the newer coniferæ, we cannot be in possession of that degree of knowledge in regard to their adaptation to this country which is necessary to all concerned. Might not our Government take up the subject, even on a more extensive scale than has been here laid down? They have extensive woodlands of their own. They have ample scope for a scheme of the kind; therefore why should they not set an example to private proprietors on a subject that is doubtless calculated to be of great benefit to the country, if properly carried out?

I should suggest that an establishment of the sort should be made in one of the midland counties, and another in one of the northern counties of England, and a third in the north of Scotland, and that the progress of each should be reported annually.

CHAPTER V.

SECTION I.—DISTRIBUTION OF YOUNG TREES SO AS TO SUIT DIFFERENT SITUATIONS IN A NEW PLANTATION.

723. Next to the draining of the soil, nothing is of more importance, in order to insure the future welfare of any young plantation, than the proper adaptation of the different sorts of trees to the various soils and situations therein. This is a point in arboriculture which has all along been too little attended to by planters in general; and the not attending to this point is in a great measure the reason that we at the present day see very many of our plantations mere eyesores rather than ornaments. I have often regretted very much to see larch and Scots pine of thirty years' standing in an unhealthy and dying state, where, if any of the hardwood trees had been planted, they would undoubtedly have proved both useful and ornamental; and, again, as often have I seen stunted-looking hardwood trees striving for existence, where, if firs or pines had been planted instead, all would have been well; which at once shows the low state of arboricultural knowledge among us. Upon a little reflection, it must appear evident to every inquiring man interested in the welfare of our home plantations, that a forester, in order to be one profitably, must be perfectly acquainted with the natural habits, constitution, and peculiarities of every tree that he attempts to cultivate; for if he is not so, the ultimate result of his work must in a great measure be left to chance. I by no means wish to say anything lightly of the qualifications of foresters; but, at the same time, I feel in duty bound to say the truth, and that is, that taking foresters as a body, there is extremely little useful practical information among them; and in order to prove the truth of this assertion, I may say, that foresters in general are not so able to cultivate the trees which grow under their notice, upon natural principles, as we find gardeners do the plants under theirs. So far as I have been able to trace the cause of this defect, I am led to think that it is the want of having proper sources of information upon their business. Gardeners have been assisted by the

advice of many able and scientific men, who have written much for their instruction; while the forester has had very little indeed written for his information. It has often been observed, that gardeners make better farmers and foresters than any other class of men; and it is the truth: but the reason is, that they have, or rather are obliged to have, a closer acquaintance with the nature of plants than any other class of men. A gardener cultivates several thousand of distinct species of plants; yet he is generally able to adapt each species to that sort of soil which is found to be best suited to its nature. The gardener, in cultivating a *heath*, for instance, gives it a light, sharp, mossy soil, and a cool dry situation; he does so because he knows that the heath, in its native country, is an inhabitant of a light dry soil, and hilly or mountainous situation: and so on with every other plant he cultivates. Now, the principal thing to be observed here is, that the gardener who cultivates his plants with the most success is he who can by his art give his plants most nearly that soil and situation which is found to be their condition in a state of nature; which is just the point that the forester ought to attend to also.

724. Foresters, knowing that trees in the natural forest develop themselves to the greatest magnitude there, ought to make themselves aware of the particular circumstances which induce or assist that full development; and upon knowing the peculiar circumstances attending the full development of each species in the natural state, they ought to make their practice agree therewith; which is the only way that any man can arrive at perfection as a forester.

725. Having in the preceding chapter entered into some detail upon the habits and peculiarities of the various species of our forest trees, it will be of importance to take a view of their geographical distribution over the continent of Europe. Such a statement I know to be necessary in order to a right understanding of the distribution of young trees in new plantations of any considerable extent.

726. Every forester ought to look upon the estate of the woodlands on which he may have the management, with the eye of a geographer. He ought to consider it as a continent in itself: each plantation may be looked upon as a separate kingdom, according to its altitude; and each of these, again, may, in the mind of the forester, be divided into provinces, according to aspect or altitude, and planted with those trees which are known from nature's own rules to be the best adapted for it. This I in all cases do myself in the laying out and planting of ground with forest trees; and as I am aware that such a method of procedure is agreeable to nature, I think it of the greatest consequence in bringing forward healthy plantations: on which account I shall here lay down the rules by which I conduct myself

in the case of suiting the young trees to the different situations in one or more new plantations.

727. All our forest trees of known worth are natives of the temperate or frigid zones. The temperate zones are inhabited by the various species of our hardwood trees, and in the extremities of the temperate zones, and under those of the frigid, we find the different species of the pine, fir, birch, and alder. The trees natural to each of these zones are not, however, always bounded by a certain degreee of latitude; for the temperature of any given place does not always depend upon its distance from the equator. Various causes have a tendency to modify the heat both of the earth and the air; such as large extent of continent, nearness to the sea, and locality as regards the east or west sides of continents or islands. The height of any given place above the nearest sea-coast also greatly affects its temperature. Elevated situations are in all cases colder than others under the same latitude near the level of the sea; and the higher that we ascend upon any mountain or hill, the lower the temperature becomes, till at last we find its summit covered with snow. This may occur upon any part of the surface of the globe, provided the mountain rise high enough; and from this we see that a change of climate does not always depend upon the degree of latitude we may be in, much depending upon the elevation of the ground; consequently, in all these places a change of vegetation takes place. For example, about the base of the Pyrenees the vine and the oak grow luxuriantly; and on going a little way up those mountains, these disappear altogether; but the pine, the birch, and the alder are found. On proceeding still farther up, the pines disappear also, and nothing is found in the shape of vegetation but dwarfish willows, heath, and mosses. And the same thing is observable in our own country, although not to the same extent. In all the lowland counties of Scotland, the oak, ash, elm, and sycamore thrive well, while upon the high mountainous districts of the northern counties they will not succeed; at this height the fir and the pine tribes are found in excellent state; while there is an altitude beyond which the fir and pine will not grow to useful size, and in their place dwarfish birch, heath, and moss are to be seen. There is one point relative to the altitude of a place which is worthy of being noticed here; and that is—supposing two situations, each one thousand feet above the level of the sea: if the one situation is the top of a hill, and the other a flat table-land of some extent, the situation upon the top of the hill will be much colder than the other, although both are of the same height; and supposing the soil to be of equal quality upon both, trees would succeed much better on the flat table-land than they would do upon the top of the hill, although the one is as high as the other:—all this pointing out that the intelligent

forester must take into consideration not only the altitude of a situation before planting upon it, but also the very shape of the surface of the ground, in order to succeed; or if he do not, he will be certain to commit errors in his profession. And as I have already said that much of the forester's success depends upon properly adapting the trees in a plantation to the different situations in it, the above observations are necessary to be kept in view.

728. The healthy growth of trees is also much affected by the peculiar locality of the part of the country in which they grow; for instance, in Norway, on the coast of the Atlantic Ocean, the oak is found growing in latitude sixty-three degrees, while in the eastern parts of Europe, on the confines of Asia, it will not grow in latitude fifty-seven degrees; this showing that the west of the continent of Europe is much milder than it is inland, and also that the sea-coast is much more temperate than a country inland upon the same latitude. Again, relative to the oak: in Asiatic Russia, upon the river Argoun, in the same latitude as London, the oak is said scarcely to exist, from the extreme coldness of the country; proving the mildness of a maritime country such as Britain, and its better adaptation for growing trees as compared with the extensive regions on the north of the Asiatic continent, and that the west of Europe is much milder than the continent of Asia under the same latitude.

729. It is generally remarked that the west side of an island or continent is milder than its east side, but this does not always hold good in regard to our own island; for it is well known that the east coast of Britain is warmer than the west. The west coast may indeed be reckoned more equal in temperature throughout the year, but our principal corn-growing counties are situated upon the east side of the island—from the Lothians in Scotland to Kent in England. The east side of Ireland is much warmer than the west of Scotland which is opposite to it; and this is occasioned by the storms from the Atlantic beating upon the west side of Scotland, while the east of Ireland is sheltered from them. Upon the east of Ireland, about Donaghadee, the most tender of our forest trees grow with great luxuriance; while upon the west coast of Scotland, about Portpatrick, which is only eighteen miles distant from the latter place in Ireland, not a forest tree of any consequence can be made to grow for a considerable distance back from the sea-shore; which proves that even in places of the same altitude, in planting trees upon them, the kinds to be chosen must also depend upon *aspect* and exposure to storm from prevailing winds.

730. With regard to the pine and fir tribes: In Norway and Lapland the Scots pine is said to attain the height of sixty feet in latitude seventy

degrees; and Von Buch says, that in Tornea, at the head of the Gulf of Bothnia, the birches are *magnificent.* Now, let us compare this with the northern parts of Britain. In the Orkney Islands, about latitude sixty degrees, scarcely anything having the form of a tree is to be met with but the hazel, which bears the winds of the Atlantic better than either the Scots pine or the spruce; this is occasioned by the extraordinary rush of storm passing along the Atlantic among the northern islands, which prevents trees from growing to any useful size. On the other hand, it is very remarkable that the spruce fir in Sweden is found eight degrees farther north than the hazel, and this occurs on the coast of the Baltic.

731. In Scotland we have extensive natural forests of the Scots pine, but none of the spruce fir, which at once points out to us that the spruce fir in our country is not nearly so hardy as the Scots pine; and in order to grow it to advantage, it must be planted in a much more sheltered situation than the Scots pine requires. Now this is the more remarkable when we take into notice that there are forests of the spruce fir in Norway as far north as latitude sixty-seven degrees, which is much colder than the climate of Scotland; but this can be accounted for by the extreme humidity of the climate. In Norway the spruce fir is found at an elevation of two thousand feet, and the silver fir at an elevation of nearly three thousand feet, pointing out to us that the silver fir is more hardy in Norway than the spruce fir.

732. Again, in Norway and Sweden it is said that the larch is not found at all in a state of nature—just as the spruce fir is not found with us; yet we find the larch and spruce in Siberia, much farther north than either the Scots pine or the birch, which is a remarkable characteristic of the country in the north of the Russian empire, and points out the larch as being more hardy than even the Scots pine in inland districts.

733. In Asiatic Russia the tree found farthest north upon the Arctic Ocean is the larch; next to it, in progressing southwards, is the spruce fir; next the Scots pine; and still progressing south, we meet successively the lime, the ash, the oak, the beech, the elm, and the poplar.

Now, if we apply the above observations as to the natural distribution of our forest trees over the continent of Europe and Asia, we shall at once see that the same natural laws, to a great extent, guide their development in our island—at least in so far as our experience leads us to form a correct judgment in the case of our artificial forests; with, of course, different modifications, according to the aspect of different parts of the country upon which they are planted. In many high-lying inland parts of Britain, the larch is well known to be more hardy than the Scots pine; while, again, in the northern parts, bordering more upon the sea, the Scots pine is found more hardy than the larch. The spruce, again, in Britain is more tender than either the Scots pine or the larch; but in this it is not so much affected by the degree of cold as by the situation it may be planted in; for example, it will bear more cold in a flat part of the country than it could do upon a high part, where it would be exposed to winds and sudden storms; and that is exactly its nature in the countries on the continent in which it is found growing naturally. The oak is also found to succeed much better in a moderately level part of the country than when exposed to sudden and frequent storms of wind; it is, like the spruce fir, not so much hurt by any degree of cold as by exposure to high winds; therefore, in general, we are led to remark that the more equal and level any part of a country is, the farther north will the spruce fir and hardwood trees be found to succeed; and the more mountainous any part of a country is, just in the same proportion will these trees be checked in extending northward. At the same time, however, in making calculations of this nature, it must be kept in view that the air upon any mountain one thousand feet above the level of the sea will, in the neighbourhood of the sea, be much more temperate than a height of one thousand feet upon a mountain far inland and away from the influence of the sea.

734. Now, what I desire to deduce from these observations relative to the geographical distribution of our forest trees is, that a forester, in planting any part of an estate, must keep all these peculiarities of the different kinds of trees in view, and plant that sort of tree which is found to answer according to *altitude* or *aspect*. As I have already said, the forester should view the estate he may have to manage as a continent in miniature, and manage all his wood operations accordingly; planting firs and pines upon all the highest parts, and hardwood in all the lower parts: and not only should he view the whole estate in this light; he should view any single plantation he may have to make in the light of a kingdom, and plant the most prominent parts with pines, and all the lower parts having a good soil with the more valuable sorts of hardwood. As this is according to nature, it not only gives the best possible effect to the plantation as an object, but it adds also considerably to the healthy growth of the whole as a plantation; for when heights are planted with firs, the hardwood under them are sheltered by them; and from being sheltered they grow quicker, and come sooner to answer the end in view.

SECTION II.—PLANTING GENERALLY CONSIDERED.

735. Planting being one of the most important operations of the forester,

every point bearing upon it, and having a tendency to secure its success, should be carefully and maturely considered before engaging in it, otherwise failure is as likely to attend the operation as success. I have often seen the planting of large enclosures let by contract to certain parties, who engaged to put in a certain number of certain kinds of plants per acre, at a certain rate. This they no doubt did, but from the neglect of definite specifications as to the work, they performed it as they thought best for their own interest; and the result was partial failure in the first place, and a stunted and unhealthy crop ever after. I repeat that such cases have frequently come under my notice, and therefore I strongly recommend proprietors to have their planting operations all done at the sight of intelligent men as their foresters, who will be careful, for their own sake, to have the work in every respect done satisfactorily.

736. Some years ago, while engaged in surveying the royal forests, in one of them I found men engaged planting Scots pines from twenty-four inches to thirty inches high, upon a bare, exposed, and open moor, and pruning them of their branches much in the same way as they would oak plants of similar strength. In my professional capacity, I reasoned with the parties in charge on the impropriety of pruning live branches from Scots pines, and also on that of using such large plants on such an exposed situation; and told them that the greater part of the plants they had thus planted and pruned would be dead before the month of April—*this* being in December. The result was as I stated, and as any sensible and experienced man might have foreseen; and I bring this under notice here in order to guard, as far as possible, others from conducting planting operations in a similar way, and committing such mistakes.

737. However judiciously specifications may be drawn out for planting operations to be performed by neutral parties, it is almost impossible that such parties can do the work either so well or so cheaply as it can be done by the proprietor's own servants. This will appear evident when it is considered that parties from a distance, say nurserymen, when they undertake to plant in the country, are obliged to hire in a certain number of hands in the neighbourhood of the work, and to send out a person to look over it for their own advantage. The work is begun and carried on to a certain extent, when bad weather sets in upon them—it may be frosty weather—and they are obliged either to stop work or go on with it, to the disadvantage of all concerned. If they stop work in consequence of the frost, the men who were employed find that it is not profitable for them to attend, and they gradually leave it off, and take other work with other parties. Fresh weather comes, and the person in charge finds that he cannot make good the number of hands he had; he becomes disheartened, and musters

together as many strangers as he possibly can, most of whom are probably unacquainted with planting, and he urges them to push on and plant a given number of trees in the day, otherwise he will be found fault with by his employers. Thus the work goes on from time to time as the weather may suit, and the result is that it is unsatisfactorily performed. This, however, is not generally found out till the following summer, when the young plants are observed gradually to lose their green colour and die. Such a state of things could not have taken place had the work been performed by the proprietor's own servants, as in such a case the hands employed could have been set to some other work when planting could not be done, and again drawn off to it when the weather was suitable.

738. In planting, therefore, all these disadvantageous states of things should be kept in view, and the work carried on on the soundest and safest principles known in the art; as if it be done in any way inconsistently—by fits and starts, and the hands hurried in the performance of the operation—failure will be the result, and repeated replanting made necessary.

739. Every judicious and intelligent forester, before he commences to plant any enclosure of considerable extent, should sit down and calculate how he is to get on with it under all or any circumstances that are likely to occur, so that he may never be taken unawares whatever may come in his way. During the planting season this can always be managed by having other works besides planting ready to go on with if the weather should prove unfavourable. We ourselves—and we plant from 500 to 800 acres annually—always endeavour to have draining, and road operations, and thinning on hand, so that at any time we can turn the men to these if we find the weather unfit for planting; and we have the whole thing so arranged that at an hour or two's notice we can muster the whole to plant when the weather takes a favourable turn.

740. In short, the planting season is and ought to be to the forester what the harvest season is to the farmer—a time of anxiety and looking out on the weather. At least, it is so with myself, and I think it should be so with every forester anxious to do his duty to his employer and to himself. The results of inattention in this respect are often very great. I have seen an enclosure of 300 acres have to be replanted to a large extent from no other cause than that of doing the work hurriedly, the forester wishing to make it appear that he could do it cheaply. But let it be kept in mind that work done hurriedly is generally only half done.

SECTION III.—SEASON OF THE YEAR BEST ADAPTED FOR PLANTING OPERATIONS.

741. Many practical planters have laid down that the months of March and April are the only proper months or season of the year adapted for planting operations. For my own part, I have planted extensively at all times between the months of October and April, both included, while the weather was fresh, and have had equal success from planting in all the different months. I may, however, say, that I always prefer the months of November and December for the planting of hardwood, and those of February, March, and April for the planting of the fir and pine tribes. If the ground intended to be planted be naturally dry, I put in both hardwood and firs in the months of October, November, and December; but if naturally wet, and the drains only recently made, I delay planting such ground till the spring months.

742. Where planting operations are not carried on extensively, it may be an easy matter to delay till a certain time in the year, as the private opinion or convenience of the party intrusted with the work may suggest to him; but where three or four hundred acres are intended to be laid down in wood in one season, it is always found necessary to take advantage of the whole season from the middle of October till April, whenever the weather will permit, in order to have the work all done before the growth of the plants begins, which is generally about the middle of April. Those who advocate planting in the spring months only, say, where planting operations are to be executed upon an extensive scale, "put on the greater number of men, and have the work done in the shorter time." But those who advise to put on a great number of men in order to have the planting of a piece of ground quickly accomplished, are not worthy of the name of practical foresters, and cannot have had much experience in the results of such operations as performed at different times and under different circumstances.

743. Every experienced planter who has had occasion to employ a considerable number of men, in order to get through his work as fast as possible, is aware of the difficulty there is in getting a large number of labourers, from any neighbourhood, properly qualified to conduct the operation well, and as it ought to be done. Common country labourers are seldom acquainted with planting operations, and require at least a few weeks' practice before they can be safely trusted; therefore it is, that when a number of inexperienced men are brought together to plant, the work is always badly done, and, consequently, is seldom attended with satisfactory

success in the end. In planting extensively, my method has always been, to prolong the season of operations, and with a few experienced men to do the work in a proper manner; and by so doing, I have generally been very successful.

744. In reading the above assertion, many may be inclined to say, that if the weather were to prove unfavourable, it would be impossible to get through an extensive piece of planting with a few men in one season; and at first sight there appears, indeed, some reason in this objection; but I answer, that very much depends upon the proper management of the work in hand. In planting extensively, with a few good hands, I do not generally begin at one end or side of the plantation, and make good all the ground as the work proceeds, as is the custom with many planters who employ a great number of men at once. In almost every piece of ground laid out for an extensive new plantation, there is generally a variety of soils and situations in it; and of this variety of soils and situations I always take advantage thus:—When the weather is fine and fresh, I set the men to plant upon the most exposed sides or parts of the ground; and when the weather is cold or wet, I set them to plant upon the most sheltered parts; while in the case of frost coming on, I always reserve for this the making of pits for hardwood, making new roads, &c. &c., which can be done during frost, and is still carrying on the work, and at the same time keeping the workmen in employment. In short, by conducting planting operations in the manner above referred to, ten good experienced men will do far more work in four months than twenty inexperienced ones in two months; and, what is of more importance, the work by the few hands will be much better done, and prove far more satisfactory in the end. Not long ago I had an interview with an old forester of fifty years' extensive and successful practice, who, while conversing with me upon the point now under consideration, told me that his rules for planting, for the last twenty years, had been, to plant dry ground with an open bottom in autumn, either with hardwood or firs, and to plant ground naturally wet and cold in the subsoil in spring; also to plant dry, light, and open-bottomed ground in wet weather, and ground naturally damp and cold in the subsoil in dry weather: to the advantages of which method I can myself bear testimony from my own experience; and any planter who will go to work upon these principles, will find the happy results arising therefrom.

745. In Strathspey this year (1859) we commenced to plant in the first week of October, with upwards of fifty men, all of whom I purpose to keep employed on such work while the weather is fresh, and on making drains, roads, and thinning, while the weather may not be suitable for planting. From thus employing so many hands we can generally put into the ground

from 50,000 to 60,000 plants in one day, and thus ensure that the desired extent may be all accomplished within the planting season.

SECTION IV.—DIFFERENT METHODS OF PLANTING YOUNG FOREST TREES.

746. In the planting of young forest trees, two different methods are in practice among foresters: the first is the method of planting in *pits*; and the second, that of planting in *notches*, either with the common spade or the planting mattock. The method of planting in *pits* should be employed for all hardwood trees, for two years' transplanted larch and pine, and for three years' transplanted spruce firs. These pits are made with the common spade, at various distances, of from three and a half to twelve feet, as the case may be; that is, if the whole of the plantation intended to be done is to be planted with hardwood and two years' transplanted firs or pine, then the whole ground will require to be pitted to the distance required, but observing to make the pits for the hardwood larger than those intended for the firs or pine. In order to do the work properly, all the pits for the hardwood should be made first, say sixteen inches on the side of the square, and fourteen inches deep; then, having these pits made at the distances, say of twelve feet from pit to pit, make those for the firs and pine nine inches on the side of the square, and ten inches deep, and just as close one to another as may be considered sufficient for the nature of the ground, say four feet over all. If, after having the pits made for hardwood upon a piece of ground, it is found advisable to plant up with one year's transplanted pine, then no more pits will require to be made there, for it is not necessary to be at the expense of making pits for any pine which are under two years' transplanted.

747. In the making of such pits as are above described, I generally let the work by contract. I cause the contractor to cut off the upper turf as thinly as possible, and lay it on one side of the intended pit; and in taking out the soil in the act of making the pit, he lays it upon the opposite side, which comes to be of great advantage in the act of planting. Where the soil is hard in the pit, the pick must be used to open it up to the desired depth. I have generally got pits made for hardwood, to the dimensions already named, for 1s. 6d. per hundred, where there are no large stones or roots of old trees, and where these do exist, at from 2s. to 2s. 6d. per hundred, and those for pine for 1s. per hundred in the former case, and for 1s. 6d. in the latter.

748. In the case of planting a piece of ground among old roots, the remains of former trees, the pits should be made at least three months

previous to their being used. By having the soil in the pits a few weeks exposed to the influence of the atmosphere, it becomes much more healthy and congenial to the roots of the young plants.

749. The manner of planting the young trees in those pits must be regulated according to the situation of the ground to be planted; that is, if the situation be a low sheltered one, I plant a tree in the centre of each pit, and, cutting the turf which comes off the surface of the pit exactly into two halves with the spade, I make them fit closely upon the young tree, with the grass side uppermost. But if the situation be an exposed one, then I plant a tree in one of the corners of each pit; and by so doing it is kept firm in its place by finding support against the sides of the pit; which method should always be practised when the trees are apt to be blown about by winds and storms. In planting trees in such pits, great care is necessary to see that they be made perfectly firm in the new soil of the pit. But in making the trees firm in the pits, no tramping or beating with the feet should be allowed until the whole of the earth is put in; for if the planter begin to beat the earth upon the roots of the young tree while they are only half covered with soil, he is sure to do them injury. Knowing the evil of this from experience, I never allow a man to beat the earth about the roots of a young tree until he has it all into the pit, when a good firm tramping with the feet is necessary in order to keep the plant properly in its place until its roots take hold of the soil. After the earth has been all put into the pit and made firm, the turf should be put over the whole as closely as possible, and made firm, in order to keep out the drought.

750. Some time ago I had a conversation with an extensive proprietor of land in the north of Scotland, who, while speaking to me relative to the different methods of planting trees, said that he was of opinion that the plan of making pits for young trees was altogether superfluous, and ought not to be practised; because upon his estate he had hitherto planted by this method, and found that the pits when made were only receptacles for holding water. Now, as it is possible that many other proprietors may hold the same opinion, I here beg to make a few observations relative to the good arising to young trees when planted in pits.

If the roots of a young hardwood tree, or a two years' transplanted fir, are put into the ground merely by a simple opening with the spade, they are so soft and tender, that they are unable to push their way through the solid earth in search of food: the natural consequence is, that if the tree does not altogether die, it grows weakly, and is long in attaining the character of a healthy tree. If the soil be of an open nature, the tree may succeed well after the roots become strong enough to push their way; but if the soil be naturally poor, and of a binding quality, the probability is that the trees planted in it without pits will die altogether.

As to the pits made for the reception of young trees becoming a receptacle for water, that can only be the case under bad management; for where the ground has been drained for young trees, the water will not stand in the pits; and where it has not been drained in the manner already inculcated, it is not in a fit state for planting trees in. Where trees are planted in pits made upon land in a dry state, their young and tender roots have at once free access into the open soil, and, consequently, the trees soon establish themselves in their new site. Generally speaking, I have found that trees planted in pits after the manner I have recommended, are ten years in advance of those planted otherwise.

751. It is, however, only necessary to plant in pits those trees which are of pretty large size, such as hardwoods and pines, two years' transplanted and upwards: trees under that age and size, having smaller roots, only require to be planted in the natural surface soil, which is generally free and open to the roots of all small plants.

752. The method of planting termed *notching* or slitting, is done with the common spade or planting mattock, and is so well understood by all planters, that it would be superfluous to enlarge upon it here. It is the practice most commonly in use for the planting of all small trees, such as two years' seedlings, or one year's transplanted pine. The great point to attend to in this system of planting, is to see that the cut or notch be properly closed about the young plant after it is inserted, which should be done by the planter using the heel of his shoe in beating the cut all quite close again. The system of notching in trees by the planting mattock is done upon the same principle as that by the spade, and is generally practised upon a thin hard surface, where the spade could not be used conveniently. Generally speaking, however, I have found the common spade answer the purpose much better than the planting mattock, and so much am I convinced of this, that in Strathspey, where we plant upwards of two millions of trees annually by the notching system, we use only the common spade, and no other implement, even on thin and rocky parts, and the state of our young plantations is such as to prove the advantages of this mode.

SECTION V.—DISTANCES AT WHICH YOUNG TREES SHOULD BE PLANTED ONE FROM ANOTHER.

753. Every proprietor of land, in planting a portion of it with trees, has in view, first, the cheapest possible way of doing the work, consistent with

future profit; second, the raising of the greatest possible rental from the land under a crop of wood; and third, the quickest possible way of producing both shelter and timber from the land planted.

754. At the present day there are speculative individuals who maintain that in planting land with young trees, they should not be put in the ground closer than from six to eight feet, making about nine hundred young trees to the imperial acre. On the other hand, all practical foresters who, from much experience, have tested the results arising both from wide and close planting, recommend putting in the trees at from three to four feet, making about three thousand five hundred plants to the imperial acre. This is an important point in arboriculture, and ought to be subjected to the test of sound reasoning combined with experience. Therefore, in order to make it appear clear to each planter how far he is to be guided by any particular rule of distance, let us consider briefly the proper and reasonable way of judging in this matter.

755. We may suppose forest bands to be divided naturally into three distinct localities—namely, sheltered and low-lying, moderately sheltered and low-lying, and high-lying and exposed. Each of these demands our particular attention, in order to come to a right conclusion as to the proper distance for planting trees. First, then, with regard to the distance at which young trees should be planted in a sheltered and low-lying situation. Every one is aware that trees will, in such a situation, grow more freely without any artificial means being used to protect them, than the same trees would were they to be planted in an exposed part. The artificial means used by experienced planters for the protection of young trees growing upon an exposed part are, to plant them pretty closely together, so that they may soon come to shelter one another; therefore, in a sheltered part of the country, where trees do not require any artificial rearing, they may be planted at any distance consistent with future good management and profit; and this must be regulated according to the demand for the various sizes of wood required in the neighbourhood. Let us take an example here of two estates, both alike situated in a low-lying and sheltered part of the country, but the one in a neighbourhood where small wood is much in demand, and the other where no such wood could be sold to advantage. In the case of the former proprietor, whose estate was situated in a neighbourhood where small trees or thinnings were much in demand, I would ask, would it be wisdom in him to plant at such wide distances that he could not thin out any for sale till his trees become nearly of timber size? This would certainly not be a wise step; yet it would be strictly according to the theory of those who advocate thin planting. They say, in all cases plant at about seven feet apart, it being for the benefit of

the trees: practical experience points out the contrary. Again, in the case of the proprietor whose estate was situated in a neighbourhood where no small wood could be sold to advantage, would it be wisdom in him to plant his trees so closely as the other proprietor, seeing he required no artificial shelter for their health, and that he could not get any of the small thinnings sold as they were taken out in order to give the others room? Undoubtedly, in such a case, his wisdom would be to plant his trees at such distances as that they could come to a size fit for useful purposes in the neighbourhood before he would have occasion to thin. In these two comparisons the whole secret as to distance in planting in sheltered localities lies. In such situations they might be planted from three to five feet, according to the local demand for wood: not closer than three feet, because, at any distance much closer, the trees would come to no useful size before they would require to be thinned for the health of the plantation; and not wider than five feet, because I consider, at distances beyond that, there would be a great loss of land, by its not being occupied; while at five feet apart, trees will be able to stand together till such a time as they will be, when cut down, fit for the most useful country purposes, without doing injury to one another.

756. Again, trees growing upon what may be termed moderately low-lying and sheltered parts of the country, or in a situation between sheltered and exposed, ought to be, laying aside every local consideration as to the sale of the thinnings, planted more closely than those in a sheltered part, and that on account of the health of the trees individually, as well as of the plantation as a whole. This is evident; for in order to make up for the shelter possessed by trees in a naturally sheltered site, those in a less sheltered part, in order to give them equal advantage, require to be planted so closely as to produce shelter to one another artificially, and that to as great an extent as the nature of the site may demand. In such situations, again, where no very small wood could sell to advantage, I would advise to plant at from three and a half to four feet apart. At distances much wider than four feet, the young trees would not prosper well, but would be much checked by exposure and want of due shelter: on the other hand, in such situations where small thinnings could meet with a ready market, I would advise to plant at from three to three and a half feet.

757. In all situations which may be termed high-lying, and therefore exposed, or very exposed, no young trees, if wished to prosper at all, should be planted more widely than three feet, whether the first thinnings may meet with a ready market or not. The great point to be aimed at in the growing of timber in such situations, is to produce shelter as quickly as possible among the trees themselves; and this can only be done by

planting rather closely in the outset. Even although a few hundred trees should be cut out as they become too close, and allowed to lie as useless and unsold, no objection should be made: they will have answered their purpose, namely, that of producing artificial shelter for a time, and of rearing up the whole as a plantation much more healthily and quickly than could have been done without them.

758. These considerations comprise, I think, the whole art of judging as to the distance at which trees should be planted in any given locality of country. This distance will, in all cases, be regulated by the demand for timber in the neighbourhood, whether that may be for small or large, or both together, and at the same time by the site of the ground to be planted. If the site be a sheltered one, the trees may be planted more thinly, as local circumstances may demand; and if an exposed one, for the sake of the general and future health of the plantation, the trees must be planted closely in order to produce artificial shelter. Having premised the above, it may here be profitable to say a little as to the consequences which would be most likely to arise were forest operations to be conducted upon the principle of thin planting, as has been recommended by theorists.

759. They say, plant hardwood as a permanent crop upon the ground at twenty-eight feet apart, and make up with firs between to seven feet over all. In this case the proprietor's views as to the cheapest way of doing the work are realised; but, I maintain, not in a manner consistent with future profit: for at seven feet apart the young trees will not come away quickly; they will remain for several years in a stunted state, growing widely to side branches, and not to proportionable height till they come the length of sheltering one another; while in an exposed site they might never come this length at all, and in all probability they would not require to be thinned before they were twenty-five or thirty years old; much depending upon the nature of the soil and site. And, moreover, a very few deaths per acre—say only forty plants—would occasion forty large gaps, each not less than fourteen feet in diameter, which would be a most ridiculous system of forest management if carried to any extent. Further, in most cases, proprietors who would plant trees at seven feet over all, as has been recommended by some theorists, would not receive one penny of income from such plantations until they were above twenty-five years of age; and even then the trees in such plantation would not be in nearly so vigorous and healthy a state as those planted at from three to four feet, as I have recommended. In short, relative to this system of thin planting, instead of being a gain to a proprietor, it would, in every sense of the word, be a decided loss both for the present and future generation.

760. Suppose that all the plantations upon a gentleman's estate were to

be planted with hardwood at twenty-eight feet apart, and made up with firs to the distance of seven feet, how could he ever produce small firs for posts or rails for general estate purposes? If he did, he would spoil the general health of the plantation by taking out even a few trees per acre. Again, at what age could a plantation so managed be expected to produce a small hardwood tree, even for any estate purpose? If any wood-merchant were to come and offer a high price for young hardwood trees of any description, how could the proprietor of such woods take advantage of it, seeing that his hardwood trees all stood at distances so wide, that he could not, without great loss, cut down even one tree till of mature age? Again, were the whole of the plantations in Britain to be conducted in this manner, what would we do for small wood of any description in the country generally? These questions seem to me quite sufficient to point out the extreme folly of parties who would recommend any proprietor of land to plant at wide distances.

Those who have advocated the system of thin planting as above stated, argue that plantations, when planted at from three to four feet, soon become too close, and that such closeness produces unhealthiness in the trees; and further, they maintain that this is the very reason why we now see so many of our home plantations in a too crowded state. That many of our home woods are shamefully over-crowded at the present day, is too plain; and, I would set my face to the utmost against such a state of things; but what is the fundamental cause of this? It is by no means attributable to planting from three to four feet. The cause is *bad management*, or rather, I may say, the want of timely thinning. Wherever plantations have been managed in the way that I here advise, and judiciously thinned, the work has been attended with the most happy and profitable results.

The whole secret of training up healthy plantations lies in the after-management. If plantations are left entirely to nature, as is too often the case, without any art being used, the trees must of course kill one another.

761. I conclude this section, then, by stating generally, that on low-lying and naturally sheltered parts of the country I plant hardwood at fifteen feet apart, and make up with nurses to five feet over all; that on moderately sheltered parts I plant hard woods at twelve feet apart, and make up with nurses to four feet over all; and that on high-lying and exposed parts I plant pine and larch only, at distances varying from three feet to three and a half feet, as the case may be.

SECTION VI.—HOW TO CHOOSE YOUNG FOREST TREES WHEN BUYING THEM FROM PUBLIC NURSERIES.

762. Every proprietor who has occasion to plant forest trees to any considerable extent, unless he have a sufficiently large nursery of his own, will find it necessary to supply himself from some respectable nurseryman. In doing so, it is absolutely necessary that healthy trees should be selected; and also those of such a nature as may be suited to the situation where they are intended to be planted for good and all.

The proprietor who intends to plant should either himself visit, or cause his forester to visit, during the summer previous to the planting season, any nursery from which he intends to purchase his supply of young forest trees, and see that the stock of young trees in it is in a clean healthy state, free from all *scale, bug,* or any other vermin generally infesting young trees.

Such a visit in the summer season may by many be considered unnecessary, but every experienced planter can bear witness to the propriety of it. I have known instances of diseased trees from a nursery being the cause of propagating the same disease through several plantations in the neighbourhood. In asserting this, however, I do not mean to say that any respectable nurseryman would be guilty of sending diseased trees to any of his customers; but I say that every planter or forester should, previous to making a purchase, go and visit the nursery-grounds, and judge for himself as to whether he shall buy or not. The proper time for such a visit is during the month of July, when the trees are in full leaf, and in a vigorous state of growth.

In that month, all young trees should have the bark upon the main stem and branches clean and free from any appearance of *scale* or *bug;* and when a little of the surface skin is removed by the nail of the thumb, the bark underneath should be of a pure, healthy, transparent green colour, not pierced by any small holes. The surface bark of a young tree in perfect health should be easily removed from the inner bark. There should be no appearance of small holes in the leaves at this season of the year; neither should they seem to have been bitten short by any insect.

763. Having visited the public nursery grounds in the month of July, and found the general health of the young trees quite satisfactory, it will be necessary for the intending planter again to visit the same grounds about the middle of October or first week of November, in order to make purchase of such trees as he may require for the season. In making purchase, it is absolutely necessary to bear in mind the nature of the ground

and situation to be planted. If the ground is a thin soil upon a high situation, then choose trees from the nursery that have stood rather wide in the rows, and have had free air and room, and are rather of a low set, bushy character, and altogether presenting a hardy appearance: plants of such a character will suffer very little indeed from being removed to a high climate. For a high situation, always choose one year's transplanted firs, and hardwood not exceeding two feet in height. If plants of an opposite character be chosen for such a situation—that is, tall slender plants, which have made long shoots of young wood the previous summer—they will be sure to suffer, and it is more than probable that one half of them will die.

764. If the situation to be planted is a low sheltered one, with a good soil, then choose tall well-grown plants for it; for in such situations there is generally a luxuriant growth of the natural grasses; and unless the young trees be pretty tall, they would be altogether choked by such a mass of herbage surrounding them. Above all, it is necessary to be most particular in seeing that the young trees chosen be well-rooted; that is, having plenty of small fibrous roots, which are the mouths by which the plant derives its nourishment from the earth. In a rather light soil, not too highly manured, the roots of young trees are generally good; but if the young trees have grown in a stiff heavy soil, there is a risk of their being badly rooted; that is to say, they will most likely have few small fibres; and young trees with few fibres never succeed well when replanted—more especially those of the *pine tribe*. Much of the success in the growing of trees in the forest depends upon a good healthy choice from the nursery; therefore this point should always be carefully attended to by every intelligent planter.

765. No proprietor should grudge to give a fair price to a respectable nurseryman, in order to have his orders punctually attended to. The gentleman who offers a fair price is always sure to have a good article sent him; while, when a proprietor offers a low price to any nurseryman for his trees, the nurseryman is not enabled to bestow that labour upon the lifting of the young trees which is necessary to secure the safety of the roots. Trees of the pine tribe, if they are lifted out of the earth carelessly, generally lose one half of their roots; and in such a case the trees cannot grow. Therefore, every planter ought to see that the trees he uses are carefully lifted from the nursery ground.

766. In purchasing the rarer sorts of pine, &c., from public nurseries, foresters should be very careful to see that they have not been tenderly reared in pits or frames, as if so, they will have small chance to succeed when planted out, even on a moderately sheltered part. All plants of this class should have stood at least one year in the open grounds of the nur-

sery, before they are sent out to the country; and the forester should be careful to see to this, otherwise he will run the risk of losing the subjects.

SECTION VII.—UTILITY OF PROPRIETORS HAVING THEIR OWN HOME NURSERIES.

767. That every proprietor of land who has occasion to plant young forest trees to any considerable extent, should have a piece of ground adapted for the raising of young trees, is quite consistent with good management in forest operations. But, except in the case of extensive hill and moorland properties, on which a large extent of planting is annually and regularly carried on, which are situated far from public nurseries, and on which, therefore, it is often advisable, as a point of economy, to establish such extensive nurseries as to supply the greater part of the young trees required,—I do not here mean to advise that every proprietor should be his own nurseryman; for the raising of forest trees to such an extent on most estates where planting is only done by times, and not regularly, would be altogether out of the question. No proprietor's forester, however well qualified he might be, can possibly have sufficient time and opportunity to attend to the minute operations of raising young trees from the seed, from cuttings, layers, &c.: but I do assert, that a piece of ground kept as a reserve nursery is absolutely necessary on such places, in order to good management.

In order to point out the utility of proprietors having their own home nurseries, and to show to what extent it is advisable for them to cultivate their own young trees previous to planting them out into the forest, I shall here detail my manner of proceeding while at Arniston with regard to this operation, and afterwards I shall also give an outline of my manner of proceeding with our nursery in Strathspey.

768. At Arniston we had about two acres occupied as nursery ground. In it we raised all our own oaks from the acorn; and as we were in the habit of getting a regular supply of acorns, we had ready for transplanting out into the forest grounds about twenty thousand every year successively. Having this piece of ground occupied as a nursery, we were enabled to raise the oaks in it to a pretty large size previous to planting them out, which was of great advantage to us, as we had very many hares and rabbits to contend with; and besides, being tall, they were not apt to be choked by long grass and weeds overtopping them. To get such large plants as we were in the habit of using there for our home woods from the common nurseries, would have been quite impracticable to any considerable extent. We did not raise all our oaks to a large size previous to planting them out,

but only a part, so far as was required. Some seasons we planted out in the home plantations several thousand oaks from three to five feet high, with strong fibrous roots; and, in order to have them strong bushy plants, we gave them abundance of room, plant from plant, in the rows, which is never the case with plants got from the common nurseries. We also raised yearly three or four thousand larches to a pretty large size, as also a number of all the common sorts of trees generally planted in the forest, which, when we had them grown to the desired strength, we planted out into the forest ground to fill up any vacancies which occurred among the young plantations; and even in some instances, where a small plantation was required to have immediate effect, I have planted up with such large trees entirely.

769. No proprietor's establishment of moderate extent can be said to be complete, as relates to his plantations, without such accommodation as I have described in reference to the nursery at Arniston. Without such a reserve nursery, no forester can have young trees at command in order to meet the demands of his employer, as occasion may sometimes require. Without such a reserve nursery, no gentleman can reasonably expect to have forest operations conducted properly. It would be folly to send forty or fifty miles to a nurseryman for a few good trees to answer some particular purpose, when the same could be got more conveniently and more safely from the home nursery; and even after sending for them, they might not be such as were expected. Difficulties of this kind I have myself experienced in certain situations; but where I have had the accommodation of a home nursery, I have been able at all times fully to meet the demands of my employer, and that at a very moderate expense. Therefore it is that, having experienced the disappointments attendant upon the want of a reserve nursery, I would here urge every proprietor of moderate extent to adopt the system of having one, merely with the view of raising a few particularly good trees for particular purposes. The extent of ground to be occupied must be regulated according to the probable demand; that is, if the forest grounds be somewhat extensive, two, or perhaps three, acres may not be too much; and if they are not, half an acre may be quite enough. In making such a nursery, never let it be in a sheltered or low-lying part, for there the young trees would be drawn up and weakly; neither make it upon a stiff clay soil, for in such a soil young trees never make good roots: but let the situation be rather an exposed one, with a light friable soil. There the young trees will become bushy and hardy, and also throw out numerous fibrous roots, which is always favourable to the healthy growth of young forest trees which have to be transplanted.

770. The foregoing statements in regard to nurseries have reference

only to such establishments as are suitable for comparatively small and moderately-sized properties. On extensive properties, say such as those on which there are from 6000 to 15,000 acres under wood, and on which there are some 300 or 500 acres of land planted annually, the case is altogether different. In Strathspey, for example, where we plant upwards of 2,000,000 of trees yearly, and where we are a great distance from any public nursery, we have a home nursery of some sixteen acres in extent, in which we rear the greater part of the young trees we require. In this nursery we keep a regular staff of people for the purpose, who attend to propagating, and to rearing the young trees of the various sorts to all the stages wanted, and by this means we are quite independent of public nurseries, and have the advantage of every tree we use being naturalised to the climate before it is planted out, which is a great matter in tree culture; and besides, from this establishment we are enabled to have our trees cheaper than we could from public nurseries. This, of course, arises from the extent being sufficient to support an establishment of people for the purpose, which could not follow the operation on a small scale.

SECTION VIII.—MANAGEMENT OF THE NURSERY.

771. In the preceding section I recommended the establishment of reserve nurseries, in connection with the woodlands, on moderately small, and on somewhat extensive landed properties, say on those ranging from 4000 to 15,000 acres in extent, on which the woodlands might extend from 400 acres to 1500 respectively, as on such sized properties planting is not generally performed regularly, but only from time to time, on a small scale, and therefore would not pay the expense of keeping up a regular nursery establishment. But on the other hand, I recommended that on extensive hill and moorland properties, say on such as might range in extent from 30,000 to 50,000 acres, and on which it was contemplated to plant annually from 200 to 400 acres for a series of years, regular nurseries should be established, both in order to facilitate the planting operations generally, and to have the supply of plants at the cheapest possible rate. As, therefore, I have found from experience that a regular nursery establishment is highly advantageous on extensive properties, where it is contemplated to plant on a large scale for a series of years, I propose in this section to lay down such a scheme of nursery culture as may be found suitable and advantageous for planting operations on large properties, say on such as those on which it is purposed to plant 400 acres annually for a period of fifteen or twenty years.

772. As the establishment of such a nursery is necessarily attended with considerable expense at the outset, the whole thing should be carefully and maturely considered by the forester who is to manage it before he embark in it. If this is not attended to, disappointment to a very large extent may ensue. In taking up the subject, therefore, I shall do so at considerable length, in order to lay down such a ground-work of the art of nursery culture as may guide any intelligent forester who may undertake the rearing of young trees, for planting out and making large plantations on an extensive property.

773. The very first point to consider is the part of the property on which the nursery should be situated; and this, of course, should be as near to the centre of the intended planting operations as possible. If, however, after fixing upon a certain field for the site, it should be found that the land is of a heavy clay nature, such a site should at once be objected to, as on it young trees could not be expected to make such fibrous roots as are necessary in order to ensure entire success in the rearing of the plantations to be made from it. In choosing the site, therefore, let it be on a light loamy soil, although it should lie a mile or more from the centre of the intended operations, as the advantages to be gained in the superior state of the plants from such a soil will far overbalance any disadvantages in regard to distance in carrying the young trees to their permanent positions.

774. The point as to soil being arranged, the next is to see whether the site is satisfactory in other respects; namely, whether it be not too much exposed to cutting winds in spring, too much surrounded by wet and undrained lands, too much sheltered by trees, or having an eastern or northern aspect. In short, all these points should be avoided, as, if the site be too much exposed to cutting winds in spring, the young plants would suffer such a check as to impair their health and vigour; if much surrounded by wet and undrained lands, frosts would be induced in the early part of summer, and consequently the young shoots of plants of early growth would be injured; if much sheltered by trees, the young plants would become drawn up and of a weakly habit, and when put out into the plantation ground, would suffer such a check as to prevent their progress for a considerable time; and if lying to the east, the effects of the morning sun in April on the plants after a night's frost would be injurious; and if to the north, the ground would be cold, and could not be satisfactorily wrought for the sowing of the seeds till the season was well advanced. In choosing the site, therefore, let the soil be rather light than otherwise; let it be neither much exposed nor much sheltered; let it be in a rather dry and cultivated part of the estate; and let it have a south or south-west

exposure if possible, or at any rate nearer to the south and west points than to the north and east.

775. These points all arranged, the next step is to ascertain what extent of ground will be necessary for the rearing of the quantity of young trees that may be required. I shall suppose that the estate on which the nursery is to be established is in a part of the country suitable for rearing oak and other hardwooded trees on the lower parts of it, and that it is found desirable and necessary to rear a large proportion of pine and larch, both for nurses to the hardwood, and for making pine and larch plantations, without hardwoods, on the higher parts.

776. In paragraph 771 I proposed to lay down such a scheme of nursery culture as might be found suitable for planting operations, to the extent of 400 acres annually; and in paragraph 775 I assumed that the sorts required would be hardwoods of all the various kinds, with a large proportion of pine and larch, both for nurses, and for making plantations, exclusive of hardwoods, on the hilly parts of the estate. The next point, then, in order to ascertain the extent of ground required for the nursery is, the proportion of larch and pine plants that are likely to be wanted, as compared with the hardwooded sorts. I shall at once define this, by supposing that 200 acres are to be planted annually on the lower parts of the property with hardwoods, and with larch as nurses; and that other 200 acres are to be planted annually on the higher portions, with an intermixture of larch and pine.

777. From this it would follow, that to plant 200 acres annually with hardwoods, at say twelve feet apart, about 61,000 of them would require to be produced annually, besides 484,000 larch as nurses; and that to plant annually 200 acres of the higher grounds with larch and pine, say in equal proportions, and at four feet apart, nearly 300,000 of each of these sorts would have to be produced to meet the annual demand; or, in all, as follows:—

Hardwoods, ...	61,000
Larch, ...	784,000
Pine, ...	300,000
	1,145,000

778. These 61,000 oaks, including a few other hardwooded sorts, which are supposed to be required yearly, will occupy a space of nursery ground equal to about three-quarters of an acre; the 784,000 larch plants will occupy another space equal to five acres; while the 300,000 pines also required each year will occupy another space equal to one and a half acre:

thus giving an extent of nursery ground equal to seven acres, one rood, as having to be cleared of its crop each year successively, in order to plant 400 acres of the woodlands annually. Next, as the oak plants, which form the great bulk of the hardwoods, must stand three years in the nursery lines before they are sufficiently strong to plant out into their permanent sites, these will require to be progressing at the different stages between one and three years—three regular successive crops of this tree, each on an extent of ground equal to three-quarters of an acre; and thus, under hardwoods alone, two acres one rood of the nursery ground will be constantly occupied. Again, the larch plants must stand two years in the nursery lines before they are fit for planting out; and as I have stated above that five acres of the nursery will be required to produce the annual quantity of that tree needed, there will, of course, be twice that number of acres necessary to keep good a regular succession of crop; that is, there will require to be ten acres of the nursery ground at all times under larch alone. The pine plants must also stand two years in the nursery lines before they are fit—except in some cases, on which it is not, for our purpose, necessary to calculate—for planting out. I have said that one and a half acre of the nursery will be required to furnish the annual quantity of that tree needed, so that, as the plants must have two years in the lines, there must be twice that extent necessary to keep up the regular supply; that is, there will require to be three acres of the nursery ground at all times under pine-trees alone. From these calculations, then, it is brought out that the whole extent of nursery ground constantly under hardwoods, larch, and pine, must be fifteen acres, one rood. Besides this extent of nursery ground, which must be kept constantly under a crop of young trees of the various successive ages required, there would also have to be a portion equal to three-quarters of an acre regularly put under green crop each year preparative for planting oak upon it the year following, and another portion, equal to five acres, would also have to be undergoing a similar preparation each year, for the planting of larch upon it, while a third portion of one and a half acres would require to be similarly dealt with, as a preparation for the planting of pine upon it the year following. In addition to these specified quantities, one acre would have to be allowed for the sowing of oak, larch, and pine seeds; nearly half an acre for manure and compost heaps; nearly one acre as borders, for layering and engrafting various species of trees; and one acre would have to be allowed for roads, walks, &c. The whole extent, therefore, of nursery ground required for the rearing of trees sufficient to plant annually 400 acres of plantation land will stand thus:—

	A.	R.	P.
To be constantly under 1, 2, and 3 years' transplanted oak, with other hardwoods, ...	2	1	0
To be kept constantly under 1 and 2 years' transplanted larch, .	10	0	0
To be kept constantly under 1 and 2 years' transplanted pine, .	3	0	0
To be kept constantly under green crop, preparative for hardwoods, larch, and pine, ...	7	1	0
Allowance for sowing seeds as described, ...	1	0	0
„ for manure and compost heaps, ...	0	1	20
„ borders for layering out, engrafting, &c. &c. .	0	3	20
„ for roads and walks, &c., ...	1	0	0
Total extent of nursery required, ...	25	3	0

779. This seems a large extent of nursery ground for the rearing of 1,145,000 plants annually, and it is indeed large in proportion to that on which public nurserymen would rear the same quantity of trees; but as in public nurseries the young plants are always crowded and drawn up, and generally no proper attention is paid to the rotation described, I am desirous to show to common foresters how a nursery should be managed in order to rear a sound and healthy stock, and not how it may be carried on so as to have their trees at the cheapest possible rate at the time of planting; as there is no doubt that the more healthily young plants can be reared the cheaper is the operation of planting in the end, and the more satisfactory its results in every respect. It is perhaps not generally known that when plants are crowded in the nursery lines so as to take up the least possible space of ground, and produce the largest possible number of them from a given extent, they are badly rooted, and many of them die when put out. Besides this evil in regard to nursery culture, I have invariably observed that in nurseries where no attention is paid to green-cropping the land regularly previous to putting young trees upon it, they are unhealthy and stunted, and are therefore subject to disease after they are planted out; hence one great cause of the unhealthiness we observe in many plantations at the present day. I therefore desire to establish among private foresters a scheme of nursery culture by which they may rear trees healthily and soundly; as I know from experience that attention to rotation of cropping, and to giving the plants free space to grow and develop their roots and tops while in the nursery, is the only way in which healthy plantations can be reared, apart from after management. I maintain, therefore, that the extent set down is not too large for the object in view—namely, for the rearing of a healthy supply of trees for annual plantations to the extent and of the kind described.

780. I may, however, state that if it were intended to rear larch and pine of the description called one year transplanted, a few acres less than has been given would be sufficient; as, in such a case, the plants named

would only remain one year in the nursery lines, and, consequently, only one compartment of ground would be annually required for them instead of two, as in the scheme I have given. But I need not comment on this point, as every intelligent forester must be aware that, according to the number of years young trees are respectively required to stand in the nursery lines, there must be a correspondent number of compartments in the nursery occupied by them, in order to keep up a regular succession for going out every year. In illustration of the point, I may mention that in Strathspey, our nursery extends to only sixteen acres, and yet we turn out of it, on the average, 2,000,000 larch and pine annually, with only a small quantity of oak. This arises from our using chiefly one year transplanted larch and pine, which can be planted more closely in the lines than when they have to stand two years, and which, besides, only remain one year in the lines, and therefore only occupy one compartment or portion of the nursery each year.

781. The extent of ground having been fixed on—based on such calculations as I have given, and, in the case under consideration, it is supposed to be twenty-six acres, in round numbers,—the next step in the order of the work is to have it thoroughly drained. This should be attended to in an especial manner, as, if not, the after prosperity of the crop will be very nnsatisfactory. The drains should be made forty-eight inches deep, and may be laid on at thirty feet apart. In filling them, stones may be used if there are plenty of them on the ground, or, if not, tiles. Whichever of these materials may be used, they should be dealt with in the same way as is usually done for the drainage of land for agricultural purposes. One point to attend to in the drainage of land for a nursery is to have all the drains made so as to empty into a deep *well* on the lowest part of the site. This is, of course, meant to supply the nursery with water, to be lifted by means of a pump; and this done, a large drain should be made from the well, so as to allow the overflow water to escape from it at a point about five feet under the surface, and one foot under the level of the drains.

782. The land having been drained in the way recommended, the next step is to have it trenched at least two feet deep. In doing this, all stones should be removed down to the size of a common hen egg, as the fewer stones there are left in the preparation of nursery ground the better will the work of the culture be performed in it afterwards. In performing the work of trenching, the land should be levelled as far as may be considered judicious, considering its general surface, as it does not suit to level after trenching, because, were this done, some parts would necessarily have to be reduced, and would therefore be made poor compared with the parts that had soil added to them.

783. The draining and trenching performed, say by the month of November, the land should be ploughed regularly all over, and left in this state to be ameliorated by the action of the frosts and rains of winter. The following season it should be properly ploughed and harrowed, so as to reduce the surface to as fine a mould as possible, and at the same time all stones that may have been left should be carefully removed; afterwards it should be drilled up by the plough, manured with good and well-rotted dung, and sown down with turnip, mangold-wurzel, or any such crop, in order to clean and enrich the soil, and bring it to a proper condition for after use as a nursery for young trees.

784. During the summer, while this green crop is being cultivated on the proposed nursery site, it should be enclosed by a proper and substantial fence, if it have not one on it previously. This may consist of a stone wall, a hedge, a wooden paling, or a wire fence. If a stone wall be erected, it need not be made more than from four and a half to five feet high, as in this case it looks well not to have a high, dead-looking fence, but one of somewhat an ornamental character; and this can easily be attained, even in the case of a stone wall, by having the copestones made flat and level, and iron uprights of half an inch square, and two feet in length, sunk and batted with lead into them, say at five feet apart, on which a wire netting should be fixed in order to keep back hares and rabbits. Such a fence as this both answers the purpose and looks well for a nursery.

If a hedge be used, both it and the nursery will require to be protected by a close upright paling until the hedge itself grow up sufficiently to answer the purpose of protection; and even when a hedge may have attained this stage, it will be necessary to protect the ground from vermin, by having a wire netting of some three feet high outside of it; as, of course, a hedge is always too open to keep back hares and rabbits.

I do not think that a wooden paling alone is generally a good fence for a nursery, unless, indeed, it is put up of a class of timber calculated to stand for some fifteen or twenty years, as it may, if constructed of well-matured oak or pine. If an upright wooden paling be fixed upon for the purpose, it should therefore be made from the very best material that can be got, keeping in view to lay a line of bricks or close-jointed stones under the fence-line all the length of it, and sunk into the earth, so that the bottoms of the wooden uprights may rest on their upper edges, in order to prevent rabbits getting access to the ground.

A wire fence suits very well for a nursery if it is in rather a sheltered part of the estate; but in any other case it does not answer so well, as it gives no protection to the grounds when shelter is most wanted; and besides, such a fence is very apt to be injured by heavy cattle, when these graze in its neighbourhood; and were cattle to break into such a nursery, with a full crop of young trees in it, they would certainly make ugly work in a very short time. I should therefore, for my own part, recommend a stone wall as the best fence for such a purpose as is under our notice, with the wire netting fixed on top as I have specified.

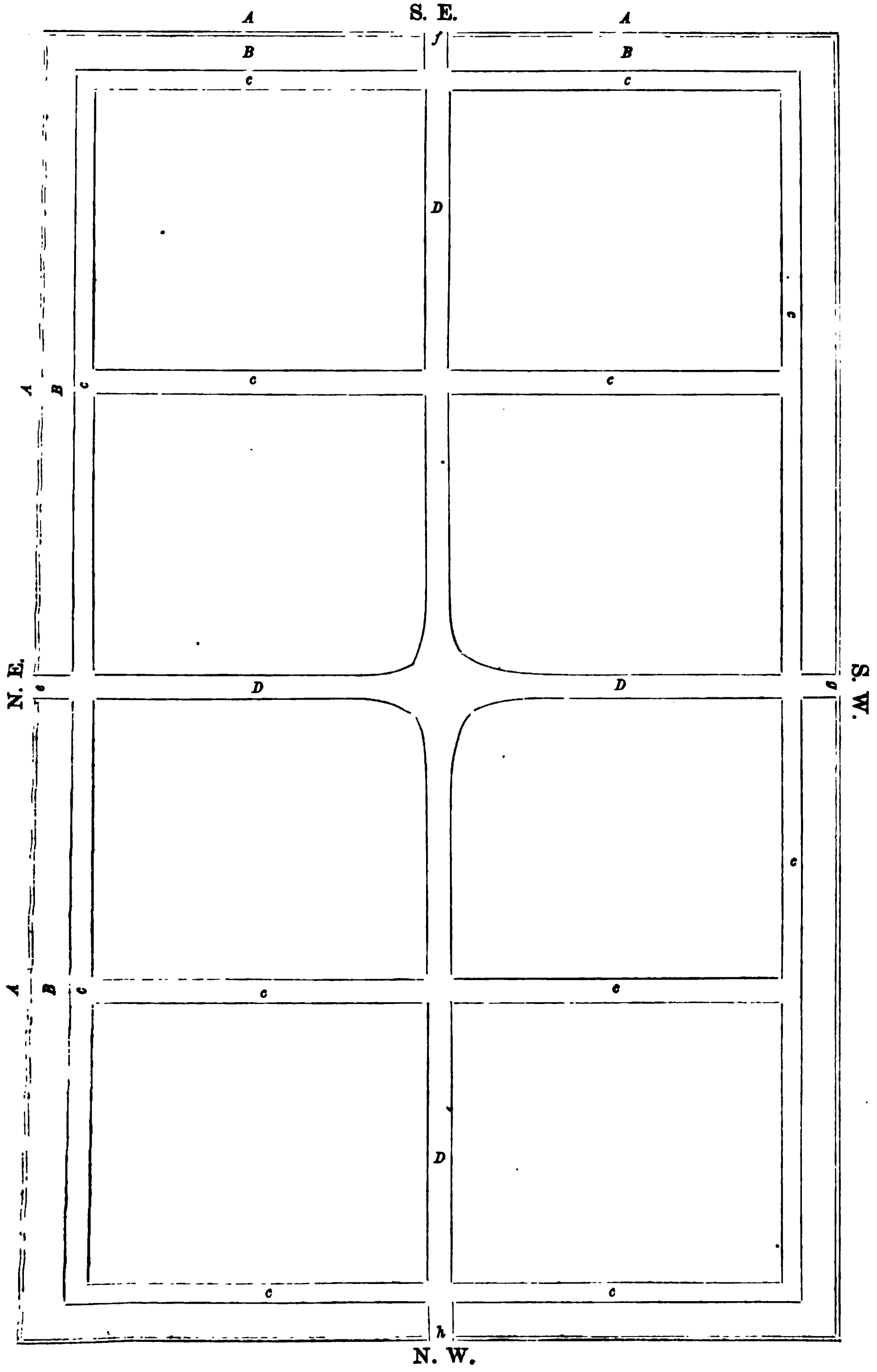
785. We shall now suppose that the nursery ground has been dealt with as has been described, in reference to draining, trenching, green-cropping, and fencing, and that the green crop has been removed from the land by the month of November. At this stage, it is proper to take an account of the whole work, in order to learn what it has cost to bring it up to this point; it will probably stand thus:—

Drainage of 26 acres of land, 4 feet deep, and 30 feet apart, with 2-inch pipes and collars, say at £6 per acre,	£156	0	0
Trenching 26 acres, 2 feet deep, and removing stones, say at £10 per acre	260	0	0
Sinking well and putting in pump, say	10	0	0
Building large drain to lead overflow water from well, say	8	0	0
Ploughing 26 acres of land after trenching, say	13	0	0
Preparing 26 acres for green crop, say	30	0	0
Gathering stones, say	8	0	0
Manure, 520 loads, at 4s. per load,	104	0	0
Seed for and sowing green crop, say	12	0	0
Thinning and cleaning green crop, say	15	0	0
Erecting stone wall, with wire netting on top, say 1452 yards, at 3s. 6d. per yard,	254	2	0
Interest on £447, as outlying for one year, say at 5 per cent,	22	7	0
	£892	9	0
Deduct from this value of green crop, say 26 acres turnips, at £6 per acre,	156	0	0
By this statement the nursery will be due the proprietor at the end of the first year of cropping,	£736	9	0

786. For the sake of clearness in illustrating the subject, I shall now suppose that we have arrived at this stage of the nursery preparations in November 1860. Then, at that time, and after the green crop has been removed from the ground, it should be again ploughed regularly over, and left in the rough state, in order to have the full benefit of the winter's frost, &c., before commencing to plant it with young trees in the following spring. The land having been thus treated, the next step in the order of the work will be to have the roads and walks all made during the winter months, and at all events before the beginning of March, when planting and sowing operations will have to be commenced.

787. I have not, up to this stage of our remarks on the nursery, said

anything as to the form in which it ought to be laid out. With respect to this point I should say that the nearer it is made to the form of a square it is the more likely to give satisfaction in regard to the respective operations of *lining*, *bedding*, and otherwise working in it afterwards. It may, however, be made in the form of a parallelogram, but on no account should the sides be made of unequal lengths, or curved, as in such cases I have found a great deal of trouble in getting the men to keep their lines—whether in the case of planting the young trees, or in that of lining off the beds for sowing the seeds—parallel with the walks and roads. When this point is not attended to, the grounds invariably look awkward and unsightly. Besides this, as a matter of economy, it is advantageous to have all the roads and walks laid off parallel and at right angles to one another; as when they are, the workmen's time is not necessarily taken up with calculations and measurements in order to arrive at certain points where other straight and parallel lines are required to agree with those in which they are engaged. By attention to this, much time and expense can be saved in the working of the whole. The following diagram will show how I should lay off the proposed nursery, with its roads and walks:—


S. E.
A
A
f
B
B
c
c
D
c
c
c
A
B
c
N. E.
e
D
D
e
S. W.
c
A
B
c
c
c
D
c
c
h
N. W.

788. Having given this diagram, I propose next to make a few remarks in description of what it is meant to represent. The double outer line *A* represents the wall or outer fence enclosing the nursery in the form of a parallelogram, with its longest sides, each supposed to be 440 yards long, lying from S.E. to N.W., and its shortest, each supposed to be 286 yards, lying from N.E. to S.W., making in all an enclosure of 26 acres. The space running along the inside of the double line, and marked *B*, represents a border of 15 feet width all round between the wall and the walk *c;* and the two cross-walks which divide each of the four great compartments into two are marked *c* also, and are all 5 feet in breadth. The roads marked *D*, and which intersect the enclosure in its whole length and breadth, are supposed to be 12 feet wide; and in the middle of each of the sides is a gateway, as shown at *e*, *f*, *g*, and *h*. The object of this arrangement is to subdivide the whole ground into convenient portions, square on all their sides, and parallel to one another, so as to facilitate all the operations as much as possible, and to keep one kind of tree quite distinct from another. In the centre of the enclosure, and where the roads intersect, there is a large space left for the purpose of turning carts, &c., when it may be found necessary to do so.

789. I have next to describe the manner of performing the work of subdividing the ground by roads and walks, as shown on the diagram. First, then, the whole land embraced should be made as level as the general surface will judiciously admit of; and this, of course, should be done in the act of trenching. This attended to, the roads from *f* to *h*, and *g* to *e*, as well as the adjoining walks marked *c*, should be made, by removing the soil from them to the respective breadths specified, and to such a depth as to obtain a pretty hard bottom for laying on road material; and in the removal of the soil from the roadways and walks, it should be spread equally over the borders and compartments, so as to improve them. The soil thus excavated, say to the depth of 18 inches, a quantity of broken stones or rough gravel should be carted and laid in them, to the thickness of at least 12 inches, regularly over all. When laid on, this bottoming should be well pressed into a compact state by the application of a heavy roller, drawn by a horse, which should be passed several times over the whole, so as to render the mass as solid and hard as possible throughout. The making of the roads and walks brought to this stage, the next step is to have an edging of some sort planted along their sides, both in order to prevent the earth from the borders and compartments falling into them, and to present a decided, distinct, and neat appearance over all the grounds. I think that the best plant for this purpose is the evergreen privet, as it is not easily injured or thrown into bad health by being

frequently trodden upon, as box and many other plants generally used for edgings are, when they are subject to rough usage. I find the privet answer well as a road-edging in our home nursery in Strathspey, and therefore recommend it to others for a like purpose. The plants for this purpose may be of the age called *one-year cuttings,* which are generally about twelve inches high. Before planting them, the earth forming the margins of the borders and compartments along the sides of the roads and walks should be carefully dug and levelled, say to the breadth of 18 inches, and afterwards well trodden with the feet, so as to prevent any subsidence following the operation. This attended to, and any unevenness of the lines made up, and the whole made smooth by a firm beating with the back of the spade, the common garden line should be stretched exactly on the line on which the hedge is to be planted, taking care that the first line stretched shall correspond with the proposed breadth of the road or walk, when the hedge on the opposite side shall be planted. The first line laid along one of the sides of one of the roads, the soil should be taken out by the spade along that side of the line on which the road is, and to the depth of six inches, taking care to do this in a regular way as the opening is made, and to lay the earth as it is taken out betwixt the opening and the edge of the stones or gravel formerly laid on the bed of the road. The opening thus prepared for the reception of the plants, they should next be laid along the smooth side of the cut, with their sides resting upon it, say at six inches apart. This operation being performed by one man, another should follow him and put the earth which was taken out of the cut back upon the roots of the plants, in a careful and systematic way, so as not to displace the plants from their positions, as they lie loosely. A third man should follow the one who fills in the earth, and should make it firm on the roots of the plants with his feet, and see that each plant stands erect in its place as he proceeds. This should be done from one side only—viz., from that next the road, and from which the soil is taken, and not from the opposite side, as that should be left level and smooth for the operation of planting in the compartments afterwards. In the same way the edging on the opposite side of the road should be planted, observing to make the opening for the plants correspond with the intended breadth; and as the same mode of operation applies to the planting of the edgings on all the roads and walks, I need not lengthen my remarks on the subject, but only state that after the plants are put in they should be all cut over to about four inches above the earth.

790. I shall now suppose that the edgings have been planted along the sides of all the roads and walks as described; the next thing to do will be to have them gravelled, which could not be well done till this stage, as, had they been gravelled before the edgings were planted, they would have

been injured by the operation of taking out the openings for them on each side. In finishing the walks, good hard gravel should be used, and on no account soft or earthy matter, as, were such applied, they would become soft and unserviceable in autumn and spring, and would be difficult to keep clear of weeds in summer. In applying the upper coat of gravel, it should be put on 6 inches deep on the sides, and from 8 to 9 inches deep in the middle, so as to secure a slight fall from the middle to each side, and thereby throw off water as it falls. The gravel laid on, it should receive a thorough rolling, as advised for the compression of the bottoming.

791. At this stage the nursery ground will be in a state fit for the reception of both the seeds and the young trees which it is intended to rear in it; and supposing that the roads and walks shall have been all completed, say by the 1st of February, the forester should then arrange—if he has not done so previously—as to the procuring of the seeds and young plants of the various sorts he intends rearing; as, during the first year of a nursery, in order to hasten the usefulness of the establishment, it will be necessary to buy in young trees of the various sorts intended to be planted out into the plantations the following year, so as to have a stock on hand for use until plants shall have been reared from seeds sown in the nursery. In order to make this part of the subject clear, I shall give a statement showing the quantities of young plants and seeds that are likely to be required in commencing such an establishment as we have under notice. The statement is as follows:—

792. Young trees required to be purchased the first year—

Oak, 1-year seedlings, . . .	45,000	£7	17	6
,, 2-year ,, ...	45,000	11	5	0
,, 1-year transplanted, . . .	45,000	40	10	0
Ash, 2-year seedlings, . . .	4,000	0	16	0
,, 1-year transplanted, . . .	4,000	2	10	0
Elm, 2-year seedlings, . . .	4,000	1	4	0
,, 1-year transplanted, . . .	4,000	2	10	0
Beech, 2-year seedlings, . . .	1,000	0	5	0
,, 1-year transplanted, . . .	1,000	0	12	6
Alder, 2-year seedlings, . . .	500	0	7	6
Birch, 2-year ,, ...	500	0	6	6
Horse-Chestnut, 2-year seedlings, . .	200	0	2	6
Spanish or Sweet Chestnut, 2-year seedlings, .	1,000	0	12	0
Lime-tree, transplanted, 4 feet high, . .	200	0	12	0
Maple, Norway, transplanted, 18 inches high, .	1,300	1	10	0
Sycamore, 2-year seedlings, . . .	1,300	0	10	6
,, 1-year transplanted, . .	1,300	1	5	0
Walnut, 2-year seedlings, . . .	200	0	8	0
Poplar, of sorts, 1-year cuttings, . .	1,100	1	13	0
Carry forward, .		£74	17	0

Brought forward, .		£74	17	0
Willow-tree, of sorts, 1-year cuttings, . .	1,100	1	2	0
„ basket of sorts, 1-year cuttings, .	200	0	4	0
Scots Pine, 1-year seedlings, ...	300,000	30	0	0
„ 2-year „	300,000	52	10	0
Larch, 1-year seedlings, . . .	784,000	117	12	0
„ 2-year „ . . .	784,000	196	0	0
Spruce Fir, 2-year seedlings, . . .	2,000	0	8	0
„ 1-year transplanted, . .	2,000	1	0	0
Silver Fir, 1-year transplanted, . .	2,000	1	11	0
Hedge plants—				
Hollies, 2-year seedlings, . . .	2,000	1	11	0
Thorns, 2-year „	12,000	4	0	0
Total for plants, . . .		£480	15	0

793. The sorts and quantities of seeds that will require to be sown in order to secure a corresponding supply of plants for the following year will be as under :—

Oak, . .	6 bush.	Horse-Chestnut,	$\frac{1}{10}$ bush.	Thorn, . .	1 bush.
Ash, . .	$\frac{1}{3}$ „	Sweet Chestnut,	$\frac{1}{2}$ „	Scots Pine, .	38 lb.
Elm, . .	$\frac{3}{4}$ „	Maple, Norway,	$\frac{1}{7}$ „	Larch, . .	314 „
Beech, . .	$\frac{1}{10}$ „	Sycamore, .	$\frac{1}{7}$ „	Spruce, Norway,	$\frac{1}{4}$ „
Alder, . .	$\frac{1}{10}$ lb.	Walnut, .	$\frac{1}{30}$ „	Silver Fir, .	4 „
Birch, . .	$\frac{1}{30}$ bush.	Holly, . .	$\frac{1}{7}$ „		

As an appendix to this statement, I may add, that the quantities of the seeds of the different sorts named in it are proportionate to, and, generally speaking, sufficient for the rearing of similar numbers of plants to those detailed under paragraph 792, of course with the exception of the poplars and willows, which are raised from cuttings, and of the lime, which is raised from layers.

794. In my statement under paragraph 792, I have given the cost of each of the quantities as I find the prices to stand this year (1860) in the catalogues of public nurserymen, while I have not given the cost of the seeds in paragraph 793. My reason for this is, that the prices of the seeds of forest trees vary so much each year, according to the plentifulness or scarcity of the crops, that it is impossible to give anything approaching to a reliable estimate on the subject; and I therefore think it better not to give the prices at all, than to state such prices as may afterwards tend more to mislead than to inform. Another reason for not giving the cost of the seeds is, that, with the exception of the sweet chestnut, which must be imported, all the other sorts may generally be gathered in good seasons from old trees in any well-wooded part of the country, by young people employed by the forester, and this at a merely nominal cost. This, at least, is our own mode of going to work in regard to getting a supply of forest-tree seeds, and I think that a similar course ought to be pursued by every forester.

795. The modes of gathering the different sorts of seeds detailed in the foregoing statement, the time of the year at which they are ripe, and the way in which they are dealt with in sowing, have all been described in the FOURTH CHAPTER of this work, so that it is unnecessary again to refer to these parts of the subject. I may, however, state, in a general way, that all seeds should be gathered *only* while they are dry, and upon no account when in a wet state ; as if so, they could not fail to spoil, and in great part to become useless. This point, therefore, should be carefully attended to in the gathering of all seeds of trees. Another point to be attended to is, to see that the seed is taken from trees in a healthy and vigorous state, and never either from young trees or from very old and diseased ones, as a large proportion of the seeds taken from young trees are found abortive, and those taken from very old, and from diseased ones, are found to want that vitality which is necessary for the ensuring of healthful plants. I have been employed very extensively to gather the seeds of trees for nurserymen in many parts of the country, and from my experience of this branch of forestry, I advise all who may attempt to rear their own trees to be very careful in the selection of the subjects from which the seed is collected; if they are not, they will not only fail to have a sufficient number of plants from the quantities of seeds they may collect, but will also be sure to have a class of plants inferior in every respect, and of such a natural constitution as to involve their becoming matured at a very early period of their existence.

796. In illustration of the point just referred to, I may state that I have known larch seed that was gathered from old and diseased trees fail to produce 1000 plants from the pound weight, while, when it is got from healthy and matured trees, it ought to give 3000. Perhaps it is not generally known among foresters, that the best larch seed that is generally collected is unfit for growing to the extent of from one-third to one-half of the number of seeds it contains, and sometimes even to a greater extent; and, as a rule, it generally follows that the greater the number of healthy seeds there are in a given weight of the seed, the more healthy and robust are the plants from it.

797. For the information of those who may wish to cultivate nursery stock to a smaller or larger extent than has been here chalked out — viz., the rearing of plants to supply the planting of 400 acres annually—I shall give a tabular statement, showing what number of plants of the various kinds usually grown in our forests may be expected, under ordinary circumstances of the health of the seeds, from a given quantity of each respectively, and embracing several other points of useful information for foresters in the management of nurseries :—

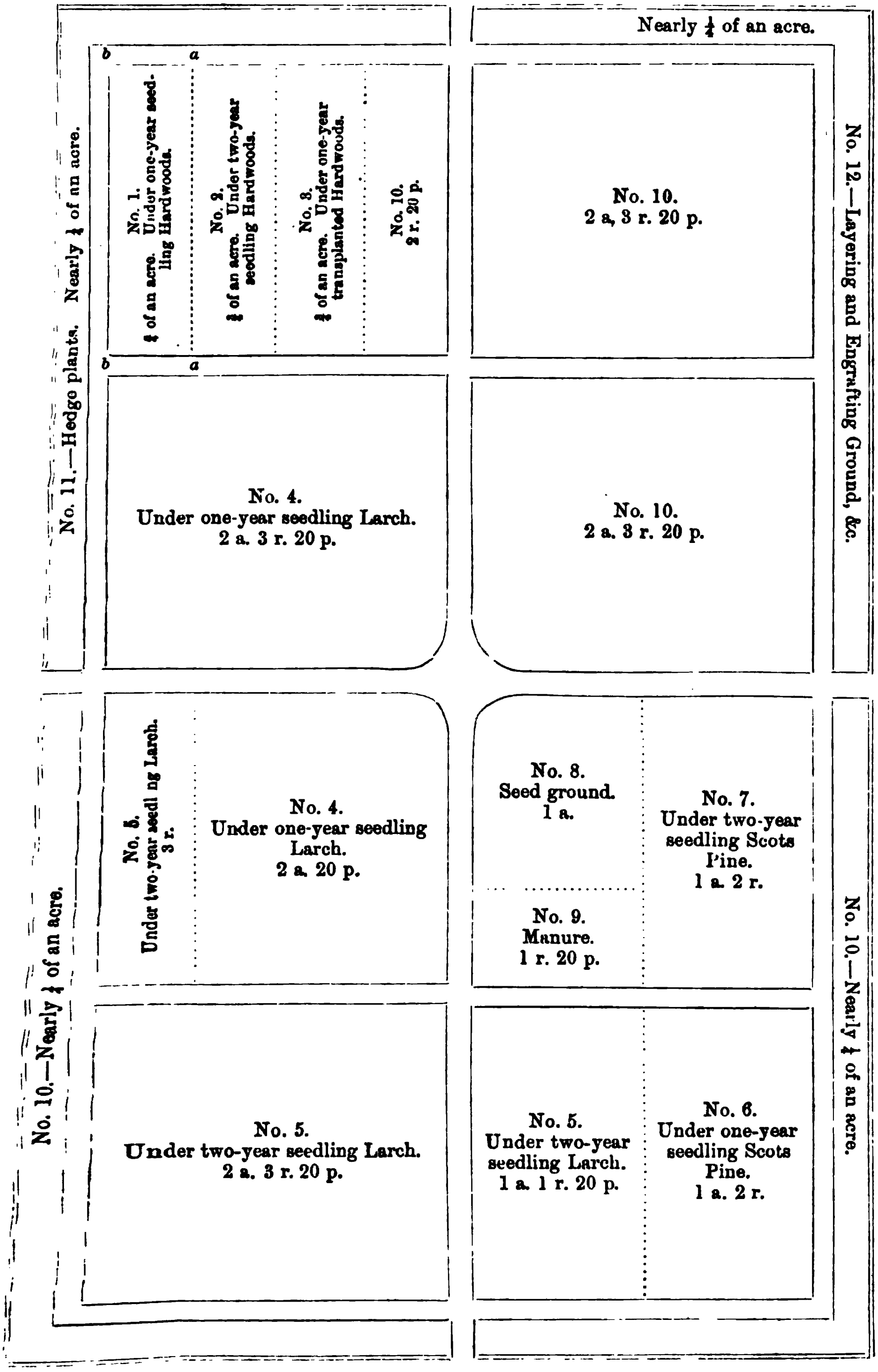
798. TABULAR STATEMENT IN REFERENCE TO THE REARING OF NURSERY STOCK.

KINDS OF TREES.	Time of the year when Seeds are ripe.	Mode of preserving Seeds till sown.	Quantities of Seeds.	Will produce of Plants.	Manner of Sowing.	Depth at which Seeds should be sown.	Distance apart of Seeds when sown.	Age of Plants at removal from Seed-beds.	Age when fit to plant out into the Forest.
OAK..............	November	In a dry airy loft, or sown when gathered	1 bushel	From 7000 to 8000, according to quality	In rows 18 inches apart	2 inches	1 to every three square inches	1 year	4 years
ELM..............	May and June	Will not preserve, but should be sown when gathered	1 bushel	From 5000 to 7000	In rows 15 inches apart	½ inch	1 to every two square inches	1 year	3 years
ASH..............	End of October	In dry sand or light earth, in order to rot the outer coat	1 bushel	From 12,000 to 16,000	In rows 15 inches apart	¾ inch	1 to every three square inches	1 year	3 years
BEECH............	End of October	In dry sand or light earth	1 bushel	From 10,000 to 12,000	In rows 15 inches apart	1 inch	1 to every two square inches	2 years	4 years
ALDER............	End of October	In a dry airy loft	1 pound weight of the clean seed	5000	In beds	¼ inch	1 to the square inch	1 year	3 years
BIRCH............	October	In a dry airy loft	1 bushel of the clean seed	From 15,000 to 18,000	In beds	⅛ inch	200 to square foot	1 year	3 years
HORSE-CHESTNUT	October	Should be sown when gathered	1 bushel	From 2000 to 3000	In rows 18 inches apart	2 inches	1 to every three square inches	1 year	3 years
SWEET CHESTNUT	Seeds generally imported	In a dry airy loft	1 bushel	3000	In rows 18 inches apart	2 inches	1 to every three square inches	1 year	3 years
NORWAY MAPLE..	Beginning of October	Should be sown when gathered	1 bushel	From 12,000 to 16,000	In rows 15 inches apart	¾ inch	1 to every three square inches	1 year	3 years
SYCAMORE........	Middle of October	Should be sown when gathered	1 bushel	From 12,000 to 16,000	In rows 15 inches apart	¾ inch	1 to every three square inches	1 year	3 years
WALNUT..........	Beginning of October	Should be sown when gathered	1 bushel	From 5000 to 7000	In rows 18 inches apart	2 inches	1 to every three square inches	1 year	3 to 4 years
HOLLY............	November	Should be rotted in a heap with sand for 16 months	1 bushel of clean seed	From 15,000 to 20,000	In beds	½ inch	1 to every square inch	2 years	4 years at least
THORN HAWS.....	November	Should be rotted in a heap with sand for 16 months	1 bushel of clean seed	From 15,000 to 18,000	In beds	½ inch	1 to every square inch	2 years	4 years
SCOTS PINE.......	November and December	On shelves in a dry airy loft	1 pound weight	From 7000 to 10,000	In beds	¼ inch	4 to the square inch	1 year	3 years
LARCH............	November	On shelves in a dry airy loft	1 pound weight	From 2000 to 3000 only, a large proportion being generally bad	In beds	¼ inch	4 to the square inch	1 year	From 2 to 3 years
SPRUCE FIR, NORWAY............	November	On shelves in a dry airy loft	1 pound weight	From 8000 to 10,000	In beds	½ inch	4 to the square inch	2 years	From 4 to 5 years
SILVER FIR......	November	On shelves in a dry airy loft	1 pound weight	About 500	In beds	½ inch nearly	2 to the square inch	2 years	5 years
PINASTER	Seeds generally imported	In a dry airy loft	1 pound weight	From 500 to 800	In beds	¾ inch	1 to the square inch	1 year	From 2 to 3 years

799. With reference to the foregoing statement, I have to add that the numbers of plants which are stated as being produced from the respective quantities of seeds do not always hold good, as the result always depends upon the quality of the seed used, and upon the state of the ground in which it is sown ; and I may add that the result is very much affected by whether the work of sowing and covering the seeds is properly or improperly performed. If the seeds are sown while the land is in a wet state, or if they are too deeply covered, the crops may be a failure, or at least partially so ; but if the land is comparatively dry at the time of sowing, and the work in every respect properly performed, and if the different seeds used are of average qualities, the produce from them will be found, on the average, pretty nearly what has been stated.

800. Having given the foregoing statements in reference to the quantities of plants and seeds required, &c., I shall next proceed to describe the modes of planting and sowing ; and in order to do this the more clearly, I shall append another sketch or diagram of the proposed nursery. Before giving this, however, I must advert to what has been stated in paragraph 791. It was there assumed that the nursery should be ready for the reception of the seeds and young plants by the first of February—which time will suit very well, in the generality of seasons, either for the sowing of such seeds as do not keep well over the winter, or for the planting of the hardwooded sorts of trees. The forester who intends such a nursery establishment as I am describing, will then have all the hardwooded portion of the plants bought in, as detailed under paragraph 792, and have them *sheughed* and in readiness on the ground for planting out into lines. At the same time, it is also understood that the forester should have gathered in the previous autumn's seeds of the oak, beech, horse-chestnut, Norway maple, and sycamore—all of which should be sown as early as possible after they are collected. All these in readiness for planting and sowing, the weather fresh and favourable, and the ground as dry as is to be expected at such a season of the year, the operations of the nursery should be commenced without delay ; and to assist in describing them, and in order to show the quantities of ground to be occupied by the different crops, I now proceed to give the diagram referred to above :—

801.


No. 11.—Hedge plants. Nearly ¼ of an acre.
Nearly ¼ of an acre.
b
a
No. 1. ¾ of an acre. Under one-year seedling Hardwoods.
No. 2. ¾ of an acre. Under two-year seedling Hardwoods.
No. 3. ¾ of an acre. Under one-year transplanted Hardwoods.
No. 10. 2 r. 20 p.
No. 10. 2 a. 3 r. 20 p.
No. 12.—Layering and Engrafting Ground, &c.
b
a
No. 4. Under one-year seedling Larch. 2 a. 3 r. 20 p.
No. 10. 2 a. 3 r. 20 p.
No. 10.—Nearly ¼ of an acre.
No. 5. Under two-year seedling Larch. 3 r.
No. 4. Under one-year seedling Larch. 2 a. 20 p.
No. 8. Seed ground. 1 a.
No. 7. Under two-year seedling Scots Pine. 1 a. 2 r.
No. 9. Manure. 1 r. 20 p.
No. 10.—Nearly ¼ of an acre.
No. 5. Under two-year seedling Larch. 2 a. 3 r. 20 p.
No. 5. Under two-year seedling Larch. 1 a. 1 r. 20 p.
No. 6. Under one-year seedling Scots Pine. 1 a. 2 r.

802. From this diagram it will be seen at a glance how I recommend to apportion the different crops over the ground. The compartments 1, 2, and 3, are each laid off, ¾ of an acre in extent, for the three different ages of oak and other hardwooded trees. The two compartments, Nos. 4, 4—the one containing 2 acres 3 roods 20 poles, and the other 2 acres 20 poles, and in all 5 acres, are laid off for the planting of the younger class of larch plants, called one-year seedlings. The three compartments, Nos. 5, 5, 5, one containing 2 acres 3 roods 20 poles, the other 1 acre 1 rood 20 poles, and the other 3 roods, and in all 5 acres, are laid off for the planting of the older class of larch plants, called two-year seedlings. The compartment No. 6, containing 1 acre 2 roods, is laid off for the planting of the younger class of Scots pine plants, or one-year seedlings, and the one, No. 7, containing also 1 acre 2 roods, for the older class of Scots pine, or two-year seedlings. The compartments No. 8 and 9, containing 1 acre, and 1 rood 20 poles, respectively, are laid off, as indicated on the diagram, for the sowing of the tree seeds, and for manure, &c. While the three compartments, Nos. 10, 10, 10, and the two borders, Nos. 10, 10, containing in all about 7 acres, are assigned for being put under some temporary crop the ensuing summer, and to be planted with young trees in the regular rotation the spring after; and the borders, No. 11 and 12, extending in all to half an acre, are laid off as under hedge plants and trees for the purpose of layering.

803. I propose now, as I could not well have done till at this stage of my remarks, to describe the method of going to work in planting and sowing the different trees and seeds. But before taking up in detail this branch of the subject, it may be well to state that the forester should, if he possibly can, have engaged for the work some eight or ten expert men, who have been formerly somewhat accustomed to nursery operations, as altogether inexperienced men cannot be expected to do the different branches of the work so well or so satisfactorily as those who have been accustomed to them, and this he can always secure by having a few, say two or three at least, who have been some time in a public nursery, and who will on that account be able to teach the others how to operate along with them. It will also be necessary for the forester to have a good spade provided for each man employed, two large harrow-rakes, with wooden heads, say 24 inches long in the head, as used by nurserymen, two middling sized iron ones, say 18 inches in the head, and two smaller ones, say 12 inches in the head, all to be used in bringing the earth to a fine state. He will also require to have provided, before the work commences, two good garden lines, on properly made reels, as well as a 12 feet long measuring rod, distinctly marked in feet and inches all its length. With these pre-

liminary instructions, I proceed to detail the work of the nursery in its order; and that this may be done systematically, I shall begin with compartment No. 1, and take up the others in their order.

804. The compartment No. 1, as indicated by its description on the diagram, is the one proposed to be planted with the one-year seedling hardwoods, as stated under paragraph 802. The only plants, therefore, which are specially intended for this compartment, are the 45,000 one-year seedling oak, as it will be observed in glancing over the statement that, with the exception of them, there are no one-year seedling hardwoods specified. As, however, the extent of ground—¾ of an acre—is more than is necessary for the planting out of this class of oak, it will be necessary to plant out in the same compartment the 4000 spruce and the 2000 silver firs, in order to fill up the whole of the compartment with plants of such a description as will be ready for removal at the same time with the oak, as these firs will be. Having made this arrangement as to the young trees that are to be planted in the compartment under notice, and having had them all properly *sheughed* at the one end of it, the workmen will next stretch their line from the one walk to the other, as shown on the diagram by the dotted line *a a*, in order to form a distinct boundary for the compartment. The line stretched as indicated, and to the desired breadth, to suit the extent of ground wanted, as from *b* to *a*, and laid down exactly at right angles with the two walks betwixt which it runs, the earth should be properly levelled, and made quite firm by beating with the feet and spade, all along the run of the line, to the breadth of about 9 inches on that side on which the work is to be performed, and 3 inches on the opposite one. This work performed in a rough way, the next point is to see that the line is stretched tightly from the one walk to the other; if one line be found too short, two can be applied, each separate from the other; and this done, all heights on the run of the line will be observed by the line lying upon them, while the hollows will at the same time be indicated by its hanging over them. To obtain a level, the heights must be reduced, and the hollows proportionately made up, until the line is observed to rest equally on all parts of the ground on which it lies, when it should be again adjusted. This attended to, the men engaged should be instructed to take out an opening, say 4 inches deep, along the whole length of the line, exact to its run, and upon that side of it on which compartment No. 2 lies. In doing this, the cut along the run of the line should be made to slope a little outwards, and the earth, as it is removed in making the opening, should be thrown upon the compartment No. 2, regularly, as the work proceeds. This opening along the line finished, it will now form the boundary of compartment No. 1, and will afterwards form also the edge of a temporary walk which will be necessary betwixt

compartments 1 and 2. The next thing to do is to have the line lifted, and again laid down, say 8 inches inwards, from the place on which it lay, and which was laid off as the boundary of the compartment. In lifting the line, care should be taken to lay it down again on the opposite edge of the levelled strip of ground, exactly parallel to where it lay, and 8 inches inwards on the compartment now to be operated on. This done, another opening should be made along its run, in every respect similar to the last, but of course this one must be sloped in the opposite direction, and towards No. 1. When these two openings have been made, a level and smooth strip, 8 inches in breadth, will present itself running, between the two walks from *a* to *a*, which will now form not only a distinct boundary to the compartment, but will also prove a guide to the workmen to keep the whole ground level as the work of planting proceeds, which is the chief object in view in the making of it.

805. The men should next be directed to level, with their spades, the earth all along the back of the hedges forming the edging betwixt the walks and the other three sides of this compartment. This may be done to the extent of 28 inches in breadth, all round, and should be very easily done, as of course it is understood that the ground along the lines of the hedges was properly level when they were planted. At all events, it will be proper to see that it is so, in order that the compartment may be afterwards kept also level from it. This attended to, the line should be stretched along the backs of the hedges, say 24 inches inwards from them, and an opening taken out along its run, with the slope inwards. The compartment will now be surrounded by a level belt or strip, from which it will be an easy matter for the workmen to keep the land level in the operation of planting the young trees, and which could not have been well secured otherwise.

806. The next branch of the work will be to have an opening taken out with the spade, along the end of the compartment opposite to that where the plants have been *sheughed;* and in doing this it should of course be taken out along the inside of the level edging just completed, but a few inches from it, in order that its smooth edge may not be disturbed by the spades. As this opening is made, the earth from it should be put into wheelbarrows and removed to the opposite end of the compartment, and there laid carefully down along its whole length, in such a way as not to interfere with the other smooth edging made along the back of the hedge, nor with the plants that were sheughed, but in a line betwixt the two. At this stage, the compartment will be in a state of readiness for planting the young trees in lines, which operation is performed in this manner.

807. Supposing that the smooth edging has been completed along the

end of the compartment, and which was specified to be made 24 inches inwards from the hedge, and that the opening has been taken out along the inside of it, say to the depth of some 5 or 6 inches, the workmen will prepare it for the first line or row of young trees, by making it as nearly as possible perpendicular, as if its side were left in a sloping position the plants could not be easily set upright against it. This prepared and in readiness, the young oak plants, which should be chosen of a strong habit, and not less than five inches high, should next be brought forward; not in large quantities, but only as many at a time as will plant say from three to four rows; and as they are thus brought from the sheugh to the ground in which they are to be planted, the foreman of the workmen should sort them evenly in his hand, and cut off the extreme points—but only the points, say not more than one inch—of the roots, in order to cause them to become more fibrous. He will then lay them down evenly and flat on the ground, and spread a little earth over their roots, in order to prevent the wind or drought from drying them; as the more carefully the plants are dealt with in this respect, the more likely are they to succeed well afterwards. The next point that the forester, or his foreman, will have to attend to will be to have the length of the row to be planted properly apportioned to the number of men he may have engaged in the work. To decide this point, we shall suppose that there are eight men employed, and that the length of the row is forty-eight yards; here, then, it follows that each man will have to plant six yards of each line as his portion, so that the forester should accordingly measure off the ground for them, and make each man, before he commences, put up two pins in the levelled border where he is to begin, at right angles with the line of the rows, and at the point his portion is to terminate, and about two feet apart. The object of this is, that when the men commence they have only to begin the first plant at the point where the eye comes in a line with the two pins set up, on the one hand, and to terminate where the eye comes in a line with the two pins on the other. By adopting this simple mode, each man will have justice in the work, and such an emulation will be sure to be excited among them as will cause it to go on briskly. These points all properly arranged, each man must next be directed to take in his hands as many plants as will be sufficient to plant his portion of the row, which is here supposed to be six yards. Then, as the plants are to be put in the rows at four inches apart, the men will each have to lift fifty-four plants for one row. Each having thus supplied himself with plants, the forester—as he ought to see that the work is properly commenced—should instruct every one separately how to lay them down on the top of the smooth edge of the opening, regularly in small quantities, say in tens, and at regular distances apart, in order to be the more conveniently handled and got at while planting them. Next, the men having the plants all arranged and laid out, each will take his position on the left hand side of the portion of the row he is to plant, and kneel down on his left knee, with his left side towards the newly-cut edging—the knee protected by a piece of old matting or other stuff bound round it, so as to prevent his getting injury from cold and damp. In this position he will take a plant in his left hand, and between the forefinger and thumb, laying hold of it about one inch above the part forming the junction between the stem and the root proper; or in other words, one inch above the part which had formerly rested on the surface; this part of the stem he will place exactly on the angle on which the line rested when the opening was made for the roots of the plants, and at the extreme left hand side of his portion to be planted, keeping the second joint of his forefinger flat on the angle, and his thumb downwards. The first plant thus held in the left hand, he will, with the right one, draw together a quantity of the finest of the loose earth lying in the opening before him, sufficient to cover properly the roots and to keep it in its place, and this he will lay upon the roots in a careful and proper way, giving it a slight press with the right hand to prevent its getting detached from the smooth wall of earth, and thereby allow the plant to fall from its place. In the same manner, each man should be instructed to plant all the young trees that fall to his portion in the line, observing to put them in as exactly as possible four inches one from another, and at the same time to be careful not to disturb the newly put in young trees by his left foot as he drags it along behind him in the opening, as inexperienced men are very apt to do till they become accustomed to the work. The plants of the first line being all put in their places in the way described, the men will next take their spades and add a little more of the finest of the earth to that already laid on the roots with the hand, but only to such an extent as to secure the roots being covered regularly with about three inches of it, when the whole length of the line of plants should have the loose earth gently firmed over their roots, by a very slight tramping with the forefoot. In thus firming the plants, however, it is not meant that the earth should be made at all hard about them, but only that it should embrace the stems and roots, so as to keep them steady, and prevent frost or drought getting easily to injure them. The work brought up to this stage, the men should next dig backwards by narrow spits, and lay the earth on, and towards the roots of the plants till they are sufficiently covered, and till the turned-up soil is one foot in breadth, or so, betwixt the plants and the opening, when a fresh adjustment of the plants should take place along all the length of the line. This should be done by the men examining each his portion, and taking hold of such of the plants as seem to lie to one side, and setting them upright by a slight pressure with the forefoot. After each man is satisfied that his plants are rightly put in, he should commence to dig the earth full up to the general level, and continue this till he has fully two feet in breadth of the dug ground betwixt the row of trees and the opening under his feet, when another edging should be made to receive another line of the young trees.

808. At this stage of the work, two pieces of wood will be required as *measuring-sticks* for laying-off the rows at regular distances, and parallel to one another. These, of course, should be provided before the work commences; and as in the case of planting under notice, the rows will have to be two feet apart, the *sticks*, as they are called, should be made exactly 24 inches in length. One should be given to the man on the extreme left, and another to the one on the right of the row, as they will have to measure the distance and adjust the line as each new edging is made. The men on the extreme ends thus provided, they will lay their measuring-sticks down, the one exactly on a line with the edging, which was cut 24 inches back from the hedge on the one hand, and the other exactly on a line with that forming the boundary on the other; and in doing this, each man will place the one end of his stick at the terminal tree of the line just planted, and mark off two feet on the edging, and place the line—which they raise betwixt them—accordingly, for preparing a new edging for a new row. This is done by stretching the line tightly between the levelled edgings running along the sides of the compartment, and afterwards levelling and beating the earth on the run of the line as before. An opening is taken out along the run of the newly-laid line to the depth formerly specified, into which to plant the second row of trees, which is performed in every respect as has been described in regard to the first.

All the oak plants intended to be planted in compartment No. 1 should be dealt with in the same way till the whole are finished, taking care, as the work proceeds, to see that the lines or rows are kept at right angles with the sides of the compartment, and perfectly parallel one to another; as if this be not attended to, and they are allowed to run diagonally, the work would look badly, and give the grounds an unpleasant appearance.

809. The one-year seedling oak plants all put in as directed, the silver and spruce firs, which are of very slow growth when young, may be planted along with them. In doing this the same mode of operation is continued, and should be begun just where the planting of the oak terminates. There is this exception to be observed, however, in the case of planting these firs. As they do not grow so rapidly as the oak during the three years they are to stand in the nursery, they do not require so much space

betwixt the rows as the oaks do; but as they form more dense heads than the hardwoods, they require to have a little more distance betwixt the plants in the rows. The distance betwixt the rows of the firs may therefore be eighteen inches, while that betwixt the plants may be five inches. Many nurserymen plant these sorts even closer than I have just specified; but in such cases the plants are always found much drawn up, and consequently weakly in constitution. With reference to the firs, I have still to remark, that although they are stated as of two ages—viz., two-year seedlings and one-year transplanted—still they should all have the same space allowed them betwixt and in the rows, as the object is to have two classes of plants three years afterwards, to suit different characters of ground, one a little taller than the other, but both equally robust and healthy. Another point to attend to in the planting of such firs in nursery rows, is to see that they are not too deeply set in the earth, as they never succeed well when this is the case. In planting them, therefore, the foreman should be particular to see that the men put them in only to the depth they have stood in the seed bed, or in the former lines.

810. Having finished the description of the manner of dealing with the class of plants specified in regard to compartment 1, I proceed to detail how the two-year seedling hardwoods should be dealt with in planting them on compartment No. 2. But in taking up this part of the subject, it is not necessary that I should enter into particulars regarding the operation of planting, since I have described this so minutely in reference to the class already referred to, and as the same mode is applicable to both. On compartment No. 2, as indicated on the diagram, it is proposed to plant all the two-year seedling hardwoods, which, according to the statement given under paragraph 792, will stand thus:—

Oak, two-year seedlings, . . .	45,000
Ash, " " . . .	4,000
Elm, " " . . .	4,000
Beech, " " . . .	1,000
Alder, " " . . .	500
Birch, " " . . .	500
Horse chestnut, " . . .	200
Spanish chestnut, " . . .	1,000
Sycamore, " " . . .	1,300
Walnut, " " . . .	200
In all, ...	57,700

There are thus 57,700 two-year seedlings to plant out on compartment No. 2, including the ten different sorts named. In preparing this compartment for planting, its boundaries should first be properly levelled and marked off as described in reference to those of No. 1, leaving an alley or little walk of two feet breadth betwixt them. This done, the plants should be brought forward and *sheughed* at one end of it, and the opening taken out at the other preparative to planting, and the oaks should have the points of their tap roots removed, as advised for the one-year seedlings; in the case of the two-year seedlings, about two inches of the tap root should be removed. The work of planting them in the rows should then be proceeded with in every respect as has been described in reference to the one-year seedlings; but with this difference, that the two-year seedling oaks, from their roots being proportionately longer, will necessarily have to be put deeper into the earth.

811. The oaks planted first, the ash, elm, beech, Spanish chestnut, and sycamore, may all be made to follow them in their order, of course keeping each sort distinct from the other; and they as well as the oak should be planted two feet apart betwixt the rows, and four inches apart in them.

812. As the horse chestnut and walnut generally grow stronger than most other hardwooded sorts while young, in planting them in rows in the nursery, they should be kept about six inches apart, but they need not be planted more than twenty-four inches row from row.

813. The birch being of comparatively slow growth, and the alder being of a somewhat slender habit where young, it is not necessary that these sorts should have more than eighteen inches betwixt the rows, and three inches plant from plant in them.

814. In planting out into nursery lines the two-year seedlings enumerated above, as they are taller than the one-year plants, with but weakly fibres on their roots, greater care is necessary to have them made properly firm in the earth than in the case of smaller plants, so that very considerable attention must be given to see that this point is properly attended to; if it is not, many deaths are sure to take place. In short, in the case of the greater part of our useful forest trees, I always object to using two-year seedlings at all, as they are always more difficult to rear than one-year seedlings; and this arises from their having fewer and more weakly fibres than the one-year class—that is, compared with the size of the plants. My reason for recommending the introduction of two-year seedlings at all into the nursery scheme I am describing, is that at the outset of such an establishment it is found desirable to use them in order to have plants for use as early as possible. In a well-regulated nursery establishment of some years' standing, this class is not generally found necessary, as there the different successions are kept up regularly from one-year seedlings, with a very few exceptions.

815. On compartment No. 3, it has been arranged that the class of hard-

wood plants called one-year transplanted should be used. According to the statement under paragraph 792, they will stand thus :—

Oak, one-year transplanted,	45,000
Ash, ,, ,,	4,000
Elm, ,, ,,	4,000
Beech, ,, ,,	1,000
Maple, Norway, ,,	1,300
Sycamore, ,, ,,	1,300
Poplar, ,, ,,	1,100
Willow, ,, ,,	1,300
In all,	59,000

In planting the different sorts above enumerated, the boundaries of the compartment are to be first marked off as already described in reference to the preparation of the others, and the kinds made to follow one another in masses respectively as stated ; putting in the oak first, and the poplars and willows last. The whole should be planted two feet between the rows, and four inches apart in them, and the tap roots of the oak should have a slight pruning in order to make them become more fibrous. Care should be taken to plant this class proportionately deeper than either of the two already referred to, as they are taller, and therefore require a deeper hold of the earth. The only rule that can safely be given in this respect, is to see that all the root part of each plant is properly covered, with a very small portion of the stem above—say not more than one inch. I make this remark here, as I have invariably found deep planting, whether in the nursery or in the open forest, very injurious to the health of the plants so dealt with. I do not consider it necessary to enter further into the planting of the class of plants under notice, as anything I could say more would be a mere repetition of what has already been stated.

816. Having now described the manner of proceeding with the three different classes of hardwoods, we next come to the one-year seedling larch, which, according to the scheme laid down on the diagram, are to be planted in the two compartments numbered 4, 4, extending in all to five acres. The number of young larch to be planted in this extent, according to the statement in reference to them under paragraph 792, is 784,000. This quantity then, planted at about five plants to each foot in length in the lines or rows, and sixteen inches row from row, will, as nearly as possible, occupy the whole of the two compartments allotted for them, after deducting allowance for alleys. As, however, it would not be found convenient to plant such large compartments as the two under notice from side to side all in one piece, for the sake of conveniently working among the young trees in them in the summer season, it will be an advantage to

have the entire compartment, or the one adjoining that in which the hardwoods are supposed to be planted, divided into four equal portions, and the other one lying on the opposite side of the middle road, and adjoining the smaller one of No. 5, divided into three. This can be easily accomplished, and ought to be the first thing attended to in the work of preparation for planting, by running alleys through them from hedge to hedge on each side, and in lines exactly corresponding to the alleys dividing the compartments supposed to be planted with hardwoods. Such a mode of subdividing such large compartments is indeed absolutely necessary, not only to the satisfactory working of the men in the time of planting, but, as we have already hinted, also while cleaning the ground. In laying off these alleys, they should be made twenty-four inches broad, and levelled on the sides, and properly edged off, in every respect as recommended for the same description of work in reference to the divisions of the compartments 1, 2, and 3. And the ground behind the hedges surrounding the compartments should also be levelled and edged off in a neat way, for the guidance of the men in planting, as formerly described in reference to the hardwood compartments. The compartments will now be in readiness for receiving the plants.

817. It is, of course, to be understood by the forester that in purchasing his seedling larch plants for a nursery stock, he should have them of a first-rate class, *stout*, and on no account of a weakly habit, as the success of the after crop from them will entirely depend upon whether he choose plants of a weakly or strong constitution. If he unfortunately choose them of the former class, the trees produced from them will most assuredly be of a similar character; while, if he have the good sense and skill to choose them of the latter description, this characteristic is an indication that they have been reared from sound seed taken from sound trees, and that a crop of good sound trees may reasonably be expected under ordinarily fair circumstances of after management. The criterion, in regard to really good one-year seedling larch, is plants not tall nor drawn up, but stout of stem, and on the average four inches high above the root, with the buds large, prominent, and well defined. Many, I know, are in the habit of choosing their seedlings of the class under notice, more for their height than for any other quality, which is a great mistake, as I have invariably found that larch seedlings are taller in proportion as they are crowded in the beds. Weakly plants may be drawn up tall so as to appear to have made great growth, while in reality they are small budded, and therefore of the most inferior description; while plants of a naturally strong constitution, under all circumstances, will present large and prominent buds.

818. The plants having then been purchased of the best character, and

laid in by the roots at the ends of the several subdivisions of the compartments opposite those at which it is intended to commence planting, the work should be at once proceeded with as advised and described in reference to the planting of the one-year seedling oak, but with this exception, that no pruning of the roots of the larch is necessary. I may here remark, however, that in planting the larch, what was stated in paragraph 816 as to the distance apart of the plants, both in the rows and betwixt them, should be kept in view and applied.

819. As each of the sub-compartments is finished, it should present a uniform level surface from side to side; and if the earth is in any way rough and difficult to reduce to a fine mould, the more time should be bestowed on the work, as unless, in the case of planting such small trees, the earth be reduced to a very fine state as it is laid to their roots, many will fail to grow, from its openness about them allowing the drought to get to them. Besides this, as the planting of each line is finished, and just before the opening for the next is taken out, a quantity of the finest of the earth from the opening or trench should be laid on the dug space, betwixt the last planted line and the trench, sufficient to fill up all interstices on the surface, in order to keep out the drought; and this should be applied even close to the stems of the plants, and when laid on it should be gently beat regularly over with the backs of the spades. All this is quickly and easily performed when each man knows his place in the work, and how to perform it. In short, in all cases of planting both one and two-year seedlings, whether hardwoods, pines, or firs, this filling up of the interstices on the surface is absolutely necessary in order to success, especially if the earth is stiff, and not naturally of a fine description, and for the same reason a gentle beating with the spades is also necessary.

820. The planting of the one-year seedling larch finished, the next class in the order is the two-year larch, which, according to the diagram, are proposed to be planted on the three portions numbered 5, 5, 5. As the subdividing of these by alleys for the convenience of planting and after working, the levelling of the boundaries, making the edgings along them, the distance betwixt the plants in the rows, and that betwixt them, are in every respect the same as has been described for the class on compartment No. 4, I need not lengthen my remarks on this class. I have to state, however, that this class of plants should be very carefully chosen, as when larch or pine have stood two years in beds they are generally so much drawn up as to be weakly both in their stems and roots. Great care should, therefore, be exercised by the forester to see that he get them from beds that have not been over crowded; and in planting them, to have their roots first carefully mulched in a fine creamy mixture of earth and

water, as if this should not be attended to, and dry weather set in shortly after planting, from the weakness of their roots it could not fail that a large proportion would die. Another point which should also be especially and carefully attended to in the planting of two-year seedlings is, that they should have their roots carefully embedded in the finest and richest portions of the soil, and that as each row is planted, the plants forming it should be well supported on the surface by the finer particles of the earth being applied to fill up all interstices on the surface above the roots, and pretty firmly beat in with the backs of the spades, so as to prevent drought from taking effect quickly.

821. The next class of plants are the one-year seedling Scots pine, which it is proposed should be planted on compartment No. 6, extending to 1½ acre. The statement given under paragraph 792 shows that it is proposed to plant 300,000 on this 1½ acre. This, then, will be accomplished after making deductions on the score of alleys for the subdividing of the compartment, by planting the young trees fourteen inches betwixt the rows, and by placing them two inches apart from one another in the rows, which is fully a greater distance plant from plant than is allowed for the same class of plants by public nurserymen ; but, of course, this is to the advantage of the plants ultimately, as thereby they have the advantage of more space to develop themselves perfectly, to attain which is our object. I need only state further, with regard to this class of plants, that in respect to the laying off of the subdivisions for conveniently planting them, and the mode of doing the work, the recommendations given in reference to the planting of the one-year larch are in every respect applicable here also.

822. Compartment No. 7 is proposed to be planted with the 300,000 two-year seedling Scots pine stated in paragraph 792; and as these should be dealt with as to distance apart in every respect as stated in paragraph 821 for the one-year seedlings, and to be treated in the mode of planting as advised in regard to the planting of the two-year seedling larch, I need not recapitulate what has been said on the subject, beyond strongly recommending the application to this class of the remarks made under paragraph 820, in reference to the choosing of plants from the public nurseries, and in reference to the care that is generally necessary in order to properly planting two-year seedlings in the nursery, whether these may be larch or pine.

823. I have now described the mode of planting the different sorts and ages of young trees out into rows in the nursery, as practised by the most intelligent and experienced nurserymen in the country ; and before taking up the subject of sowing the seeds of the different trees it is intended to

rear—which branch, according to the order of the numbers on the diagram, falls next to be discussed—I think it desirable to give a few paragraphs in explanation of certain points bearing upon the work, and which the forester should properly understand and keep in view, in regard to the working of the nursery generally.

824. I stated in a former part of this section that the work of planting should be begun not later than the 1st of February. This statement might lead many to suppose that the month named was considered the best time for commencing the work. I do not, however, mean to infer this, as we ourselves begin our nursery operations in the month of November, and continue them throughout the winter while the weather is fresh, and therefore favourable, even till the middle, and sometimes till the end of the month of May. My reason for having recommended the month of February for beginning the work, in the case of the nursery under notice, is, that as the whole of the ground devoted to it had been under green crop, and only supposed to be newly cleared from it, and as the roads and walks had to be laid off on it, made, and completed, as well as the edgings along the sides of them, before the work of planting could be properly commenced in the compartments, sufficient time had to be allowed for the proper performance of these operatious; and therefore I allowed the months of November, December, and January for them, with the restriction that the work of planting should be begun by the 1st of February at latest. With these explanatory remarks, I recommend, what we do ourselves, to commence the planting of the hardwoods into rows in the nursery, immediately after they have sufficiently ripened their shoots, which is generally about the 1st of November. By attention to this point, the hardwoods will, in all probability, be got put out at any rate by the end of December, when the work of planting out the pines and larch will be got better and more leisurely attended to in the spring months. But upon no account should the operations of the nursery be performed in frosty weather; as if so, the very tender fibres of the young plants will be killed, and their after progress affected in consequence.

825. I have just recommended that no planting of the young trees in the nursery should be performed in the time of frost. On this point I may remark, that in making experiments on the subject for my own satisfaction, I have at times allowed our men employed in the nursery to plant while the weather was frosty, and I have invariably found the after progress of plants so dealt with very much inferior to that of those put out while the weather was fresh and open. This I state for the information of foresters who may have nurseries to manage; and strongly advise them, as they value their reputation, not to run the risk of performing any work of lift-

ing or planting young trees in the nursery while the thermometer indicates more than two degrees of frost on Fahrenheit's thermometer.

826. Supposing that a staff of men are kept especially for the nursery work during the winter and spring seasons, and supposing that the digging of the green crop compartments has been completed, and that, therefore, no other work presents itself on the ground for the nursery staff during frost, the forester should at once decide upon drawing them off to thinning or draining in the woods and woodlands, so that they may be kept in profitable employment; as, when the weather changes to fresh, they can be brought back to the work of the nursery.

827. The forester who has the management of a nursery should be very careful to attend to the planting of small seedlings while the weather is decidedly fresh, and even somewhat wet, as their fibres are very tender, soft, and therefore easily injured by sharp drying winds. There is not, however, so much danger in this respect in the winter as in the spring months. It sometimes happens that when there is a large extent of woodland to plant in the autumn, all hands are called off for the purpose of having this performed; especially when the season happens to be generally unfavourable for planting, so that it has to be done by times as found suitable. In such cases the nursery work is unavoidably neglected for a time, in order to get forward that of planting in the enclosures; so that from this cause it will often happen, under the best management, that the nursery work is for the most part to be performed in the spring months, and after the planting in the plantations has been got well through for the season. According to the state of the weather, this often happens with ourselves in regard to our nursery work; and when it does, I make it a point—if the weather be at all windy and drying—to dip the roots of all the young plants into a creamy puddle, immediately on their being lifted from the beds, and before they are put into the sheugh. This prevents the air from taking effect upon their roots, and keeps them safe till planted. And besides, if the weather should continue dry, and little rain fall to moisten the plants, as each line is planted out I give the roots a thorough saturating with water from the *rose* of a pan; and I have found that when these points are carefully attended to success follows.

828. In the autumn of 1857, the weather in Strathspey happened to be very changeable—sometimes frost, sometimes snow, and sometimes fresh; and having a large extent of new enclosures to plant while the weather was at all suitable, we could not get on with our nursery work till well on in the spring of 1858. As the weather was very dry, I adopted the mode of mulching and watering just referred to, and continued the planting of seedlings till the middle of May. The result was most satisfactory; so

much so, that we never had a better crop even under the most favourable state of weather. This goes to prove that a great deal of the success of the nursery must depend upon the discernment and judgment of the forester; and that, unless he has the best interest of the work at heart, he will not be likely to succeed. I make these remarks for the encouragement of foresters, and to show them that much can be done by good management, and that much will always depend upon their own exertions as to whether the work of planting in the nursery succeed well or otherwise.

829. The next subject proposed to be referred to in connection with the nursery is the sowing of the tree seeds, as specified under paragraph 793, and which, according to the diagram, are proposed to be sown on compartment No. 8, extending to one acre. Having given the tabular statement under 798, it seems almost unnecessary to make any other remarks in regard to this operation, as this statement itself shows at a glance all that is necessary to be said on the subject. In short, this statement gives a condensed view of the modes of rearing the several sorts specified in it, from the sowing of the seeds to the time the plants should be planted out. I consider, therefore, that with this statement, and the remarks made in the foregoing part of this section, together with those made in the fourth chapter of this work, on the nature of rearing each sort of tree respectively, any intelligent forester could be at no loss to undertake the sowing and rearing, to planting state, the different sorts of trees referred to. For the sake of the young men in the profession, however, who may not have had the advantage of practical experience in any public nursery, I shall give very short directions for the sowing of each of the sorts of seeds stated under paragraph 793.

830. The first in order is the oak. In providing the acorns, as I formerly hinted, great care is necessary to see that they are of such a quality as to insure a healthy and strong-constitutioned class of plants. If this point is not attended to, and the seed got of an inferior description, the plants will assuredly be worthless in consequence. I have myself, in the course of my experience in the rearing of the oak, invariably found that the larger the acorns, the stronger and the more healthy are the plants produced from them, and, therefore, the better is the class of timber trees also. The acorns should be collected only from trees that have arrived at considerable age, and are of large magnitude as timber, and healthy in all their parts. Seed gathered from comparatively young trees, although seemingly of fair size, seems to want that degree of vitality which is necessary to produce strong healthy plants; and seed gathered from very old trees, especially if in a state of decay, is small, and therefore unfit to produce sound-constitutioned plants. I shall suppose that the acorns have

been collected of a proper description, say in dry weather, some time in the beginning of November, and of the quantity required—namely, six bushels. As they are gathered, they should not be put into bags—unless, indeed, they are to be carried a considerable distance, in which case it will be necessary to bag them for the sake of convenience in carriage—but carried home in open baskets, and stored thinly on the floor of a loft till the desired quantity is secured. While they are being gathered, a piece of ground should be prepared for them on the part of the nursery on which it is intended they should be sown. This preparation is only to dig the ground very finely, and to use the large rake as the work of digging progresses, in order to bring it to a finer mould than could be done by the spade alone. All in readiness for the sowing, this should be done in parallel rows, eighteen inches apart, centre from centre. My own plan of the operation is to sow the acorns on the surface; and this I do on a good day, when the earth is pretty dry, and when the particles of it do not readily adhere to one another. I first stretch the line from side to side of the compartment, and where the first row is intended to be sown; next, I take a quantity of the seed into an apron, tied on for the purpose of holding it, and, beginning at the one end of the line, I go along, keeping one foot on each side of it, and place the acorns, as nearly as I can judge, one to every three square inches, and keeping the row of seeds on each side of the line, and from five to six inches broad, taking the run of the line as the middle of the row. The first row thus sown, I remove the line to the distance of eighteen inches from its first position, keeping it parallel to the first row; and in the same way I continue to sow in lines till all the seed has been sown. I next cause a man to take his spade and lift, in a direct line along betwixt the first two rows, keeping his spade in a line with the surface of the earth, a quantity of the surface soil, sufficient to cover the seed to the depth of fully two inches; and this he lays on the first row in spits of the desired thickness, till the whole seed of the first line is covered; then he does the same with the next line, and so on. By this mode of covering with the spade, the seeds are covered in an equal and careful manner all over, which I have found cannot be so well done by the old mode of covering with the rake or the hoe; as when these tools are used, many of the seeds are displaced, and they therefore come up irregularly. The seed thus sown and covered, a fine rake should be used to smooth the earth by which it is covered; and as the man proceeds with the operation, he should be instructed to take care not to disturb the seed by raking deeply, as is very apt to be done by inexperienced hands. At the same time, he should be instructed to smooth the ground betwixt the rows of seed, in order to make the whole look well. The advantage of sowing the seed on the surface may not at first sight appear evident; but it is, notwithstanding, a great advantage over the old mode of opening drills for the seed. By sowing on the surface, and by taking out the earth betwixt the rows for covering, the seed is kept on a dry bed all winter, as the water has always a tendency to be drawn towards the hollows betwixt the rows, and from this the plants come away early in summer, and have the advantage of ripening their wood early in the autumn. The very opposite of this is generally the case in regard to plants raised from seed sown in drills.

831. In the economy of the country, the ash is not such an important tree as the oak. Still, in rearing it as timber, care should be taken to gather the seeds from healthy and strong constitutioned parents. Having been collected in the month of October, they should be mixed with sand for rotting their coats, and treated as recommended in Chapter Fourth of this work, where special reference is made to the ash. The mode of sowing the seed of this tree is in every respect the same as that just recommended for the sowing of the oak, with this exception, that the ash is generally sown in rows 15 inches apart, in the month of March, after the coats of the seeds have been rotted in the heap, and that they are covered with only three-fourths of an inch of earth.

832. The elm generally ripens its seed in June, and must be collected from the trees before it falls. It also is sown in lines fifteen inches apart, one seed to every two square inches, and covered only with half an inch of soil. In sowing the seed of this tree, it must be kept specially in view, however, that as the seeds are very soft and tender when newly gathered, and therefore easily injured, the soil in which they are sown, and with which they are covered, should be made as fine as possible, and the operation should be done on a dry day, when the earth has no tendency to bind or adhere to the seeds, as this would have a tendency to rot them.

833. The beech is not a tree now much used in plantations, at least in an economical point of view. As it is, however, a very ornamental tree, and excellently adapted for hedging, it is found necessary to rear it in nurseries for such purposes.

The seed of the beech ripens freely in the generality of seasons, in the months of October and November, and is easily gathered as it falls from the trees, when it should be mixed with sand to be preserved till March, when it is to be sown. In doing this it is to be sown in lines fifteen inches apart, one seed to every two square inches, five inches broad in the rows, and covered with about one inch of earth. This is a very hardy and free-growing seed, but the plants are always small at first, and therefore they require to stand two years before they are fit to be put out into nursery rows.

834. The alder ripens its seeds in October and November (see directions

in regard to collecting the seed of this tree in Chapter Fourth), and should be sown in the month of March following. The seeds are sown in beds generally four feet broad, and on pretty finely prepared earth, in the proportion of one seed to the square inch, and covered with about one-fourth of an inch of earth. The way I sow in a bed such a small quantity of seed as that I am referring to—viz., one-tenth of a pound—is this: I lay off the bed to the length required to sow the quantity, and if I mean to sow birch seed at the same time, I generally find that one bed, taken from side to side of the compartment, is enough for the sowing of the seeds of both these sorts. This arranged, then, the ground dug very finely, and reduced to a still finer state with the rake, and the bed laid off four feet broad, by having an alley run up each side of it—say twelve inches broad—a thin shovelling of some two inches is taken from the alleys with the spade, in a regular manner, from end to end, and spread from both sides over the bed lying betwixt as evenly and equally as possible; so that, when the bed is thus shaped, it will present a regular flat table, nearly four inches above the level of the bottoms of the alleys. After the earth has been added to the bed from the alleys, we next rake the surface to a very fine texture, bringing all stones and rough particles into the alleys from either side; and after we have its surface reduced to as fine a mould as possible, I give it a regular but not heavy beating, with the back of the spade, or pass a light roller over it, so as to render the whole surface as even as possible. I next sow the seeds, and have them covered to the desired depth with the finest mould, previously prepared by passing it through a sieve. After this mould is laid on—and it should be laid on very evenly and equally—the surface of the bed should be smoothed, either with the back of the spade or by passing a light roller over it, so as to make the particles lie close together, and thereby prevent the drought from taking effect upon the seed; and this done, the edges of the bed should be properly lined off, and the rough particles removed from the alleys.

835. With regard to the sowing of the birch seed, I need only state that it is to be dealt with in every respect as has been advised in regard to that of the alder. As the seed, however, is very small, and a considerable proportion of it generally abortive, it should be sown rather thickly—say 200 to the square foot; and as it is easily rotted if too deeply covered, care must be taken not to overdo it in this respect. In short, the slightest covering of the very finest earth is sufficient for the seeds. This requires to be put on very equally all over, and should not be disturbed with the rake, but only have a smooth with the back of the spade, or a light roller passed over it.

836. The horse-chestnut, the sweet chestnut, and the walnut, are to be sown in every respect as has been described in reference to the oak.

837. The Norway maple and sycamore are also sown on the surface of the ground, in rows fifteen inches apart, and at the rate of one seed to the three square inches, but they are only covered to the depth of three-fourths of an inch.

838. The seed of the holly, after having been rotted in a heap mixed with sand, or any fine earth, for a period of fifteen or sixteen months, should be sown in beds in the month of March. The surface of the bed should be smoothed with the back of the spade before the seeds are laid upon it; after they have been sown, they should be covered with about half an inch of the earth from the alleys. The earth should be made moderately fine for the covering of this class of seeds, and should be laid on equally and evenly; and it is an improvement to pass a light roller over the bed when finished, in order to prevent too sudden drying of the earth on the surface. In sowing the holly seeds, as they are mixed with sand, the better way is, as they cannot be well separated, to sow both together, and in allowing the quantity of seed to make an allowance at the same time for the sand amongst it. The seed seldom or ever comes all up in one year, but continues to come up for two successive years.

839. The sowing of the haws, or seeds of the thorn, is dealt with in every respect as recommended for that of the holly.

840. For the manner of collecting the seeds of the Scots pine, larch, Norway spruce fir, silver fir, and pinaster, and for the way in which we go to work in the sowing of it in the nursery, I have to refer to the remarks made on this subject in that part of the Fourth Chapter of this work where special reference is made to these trees.

841. In sowing the seeds of the different trees referred to, special care should be taken not to do this but in dry weather, as if the work should be attempted at any time when the particles of the earth readily adhere by any slight pressure, it would, from this cause, injure the vitality of the seeds, and prevent a large portion of them from vegetating. I have to recommend, therefore, that the work of sowing should never be undertaken till after some days of dry weather, and when the rake can be used freely without any of the earth adhering to it.

842. As it is desirable to make the ground very fine, as a preparation for the sowing of all the smaller seeds, and especially for those of the pine and larch, all the three different sized rakes formerly referred to should be used for this purpose, and should be kept in operation as the men turn over the ground with their spades. The method of using the rakes to bring the ground to a very fine surface for the sowing of the smaller seeds is this: the men who are employed to dig begin each at the same end of the opening, and proceed digging to the other end; and they proceed in a

regular manner, one after the other, each turning over to the other side of the opening before him about five inches of the solid ground on which he stands. These are followed, first by a man with what is termed the *harrow rake*, being a large rake with its teeth four inches long and three inches apart; with this he breaks thoroughly the earth as it is turned over by the men with the spades. He, again, is followed by another man with a rake, having its teeth three inches long and two inches apart, and with this he rakes the same earth which has already been raked by the large rake before him; and the third follows the other two with a smaller rake than that which the man before him has—generally the teeth are one inch apart, and one and a half inch long. The men proceed digging and raking in this way, one party following the other from side to side, till all the ground to be used has been subjected to the operation, and as each raker proceeds, he clears the ground from all stones, &c., that he can lay hold on with his rake, and draws them down into the opening, so that the third rake makes the land pretty fine. But, besides this, if it should be found necessary to make the ground very fine, a fourth man, with a still finer rake, is made to follow, so that in this way the land intended to be sown may be brought to any state of fineness by the use of rakes of different sizes. If, however, in the act of digging and raking, the land be found to adhere to the tools, it is an indication that it is not in a fit state for the operation, which should therefore be given up till the ground be found so dry that the rakes can be used cleanly. While the weather continues good and favourable for the purpose, no time should be lost in having the seeds committed to the earth; and, in order to facilitate this, another party of men should follow those employed in the preparation of the ground, who should prepare the beds, sow the seeds, and cover them, so that by this simultaneous process no time is lost by bad weather intervening betwixt the time of preparing the ground and having it sown, which is always a great advantage in work of this kind, more especially as, when the ground has been made so fine as I describe, it is long in becoming sufficiently dry should wet weather come on.

843. Having finished my remarks in regard to the sowing of the tree seeds, I now come to take up the subject of manures for the nursery, for which, according to the diagram, a portion of ground has been allowed, extending to 1 rood 20 poles, and numbered on the diagram as compartment 9. The object of devoting a part of the nursery ground to this purpose is, that all weeds, &c., may be collected and put upon it in heaps to rot, and that leaves and all other waste vegetable substances may be also collected and brought to it, there to rot and be mixed up with lime and new earth for being afterwards laid on the land as manure.

844. It must be kept specially in view, that land kept as a nursery for

the rearing of young forest trees must upon no account be kept in a highly manured state, as, if so, such an undue excitement is given to the young plants as causes them, when removed from it to a poorer soil, to become stunted and unhealthy for some years afterwards, and until they become well established in their new sites. This state of things will therefore be avoided by every intelligent forester who wishes to excel in his profession, and who wishes to do justice to his employer. I have therefore to recommend that after the new nursery shall have got one fair manuring with farm manure—which it generally requires at first when the land is newly trenched and taken in, as in this state there seldom exists much vegetable matter in the newly turned up earth—it should afterwards be manured chiefly with *road-scrapings*, *lime-rubbish*, or a small quantity of *lime itself*, mixed with well-rotted weeds, leaves of trees, or turf, and fresh soil carted from old fences or the boundaries of fields. In short, after the nursery ground has got one dose of farmyard manure, in order to enrich the inorganic parts, the only manure used should be such as I have just stated. In order to grow green crop sufficiently good on land of this description, on which little farmyard manure is laid, it is only necessary to apply bone-dust, or any other of the artificial manures in general use; and in all cases the leaves of the green crop should be left on such of the compartments of the nursery as are just cleared of it. Attention should therefore be paid to keep a large store of such earths and rotted vegetable substances in the manure compartment, and to see that, as the properly prepared portions are laid on the land, fresh quantities are collected for successive use.

845. The two compartments Nos. 10, 10, together with the two borders Nos. 10, 10, extending in all to about 7 acres—on which it is intended that the seedlings from the present year's sowing should be planted next year, and on part of them the tree seeds be also sown next year, as they are not required to be used for any nursery crop till the following winter and spring—should for the summer be sown with any grain crop that may be considered best for the district, as by doing this a remunerative return will be got from the ground while it necessarily lies unoccupied by any other crop. By taking a cereal crop from this portion of the land, it will not be the less fitted to receive the rotation of young trees afterwards, as it can be dug over in the month of September or October, immediately after the crop has been harvested from it, which will cause the stubble to rot, and improve the land before the seedlings are planted on it.

846. On the border No. 11, as indicated on the diagram, it is intended hollies and thorns should be planted for hedges. Under paragraph 792 it will be seen that I have made allowance for 2000 hollies and 12,000 thorns. These, then, I propose, should be planted on the border marked

No. 11. In planting the hollies, the work is performed in the same way as has been described in regard to the other seedlings, and they may be put in two inches apart in the rows, and at the distance of fifteen inches, row from row, and the thorns may be planted similarly. The hollies should be well watered at the roots as they are planted, as they are very apt to suffer from removal in dry weather: my own plan is to remove them on a wet day in the month of May, just when they are beginning to show growth; by adopting this mode, I have been very successful in the operation.

847. Border No. 12, as indicated on the diagram, I propose, should be devoted to such plants as have to be wrought by layering and engrafting, such as the lime-tree and English elm of the former class, and the varieties of the holly, beech, ash, sycamore, and elm, of the latter. In the statement under paragraph 792, 200 lime-trees have been allowed for the purpose of layering on the border under notice; and if it should be wished to rear the English elm also, an equal number of these may be bought in for the purpose. For the mode of planting these in the nursery ground, and for that of propagating plants from them by layering, see the remarks and recommendations on the subject in Chapter IV., on the propagation of the English elm.

848. As to the mode of extending a variety of any plant or tree by engrafting, it would be, I think, superfluous to make any comment on the subject, as I am well aware, from my own experience, that no written description I could possibly give could enable a man to do such a fine piece of work so satisfactorily as to answer the end in view. I have never known a man who could successfully do the work of engrafting who had not spent a considerable time in performing it under the eye of an experienced operator. It is not so much the mind that has to be taught on the subject as the hand. As well may we expect that an artist could make a good woodcut by reading a description of the operation, without having his hand exercised in it, as that a man could engraft from a written description without his hand being taught by practice. I would, therefore, recommend, that any man who wishes to become a successful engrafter, should attend for one season in a public nursery, where the art is necessarily carried to the highest perfection, and where there are men capable of giving more instruction in one day on the subject, simply by teaching the hand how to operate on the subjects, than could be given by writing a volume on it: he will find his time well spent. In short, there is no other way of really acquiring the art. On borders Nos. 11 and 12, besides the plants for hedging, and the plants for layering and engrafting, there may be planted evergreens of sorts, as well as specimens of the various new sorts of pines, &c., and also cuttings of various plants that may be wanted.

849. I have now described generally the mode of planting and sowing the nursery ground the first year; and after the works described have been all completed—and they should be so by the end of May—it will only be necessary to keep the planted ground and seed-beds clean from weeds all the summer afterwards. In doing this, especial care will have to be exercised by the forester to destroy weeds among the planted trees with the hoe in dry weather, before they grow to any considerable size, as, if left till strong, the work will become costly, and more difficult to perform. In keeping the seed-beds clear from weeds, the work should be done as much as possible in damp and cloudy weather, and the weeds should be removed as soon as they rise above the surface, and before they attain any degree of strength; as, if they are removed in strong sunshine, the earth will be so loosened about the plants as to admit of drought injuring their roots; and if the weeds are allowed to get strong, they cannot be removed without pulling up with them large quantities of the young trees.

850. At this stage of our remarks on the management of the nursery, it falls that I should bring up an account of the expenditure that has been made upon it up to the end of the second year, which I shall suppose to be the end of November. In all probability it will stand as under:—

Sum outstanding on nursery at the end of the first year, and as particularised under paragraph 785, . . .				£736	9	0
To making, say 2000 yards of roads and walks, at 1s. per yard,				100	0	0
„ 24,000 privet plants for sides of walks, at 10s. per 1000, .				12	0	0
„ cost of young trees bought in for the nursery, as per statement, paragraph 792, ...				480	15	0
„ supposed cost of tree seeds, as per paragraph 793, . .				20	0	0
„ planting 2,349,900 plants, as detailed under paragraph 792, say at 1s. per 1000 over all, ...				117	9	10
„ expense of sowing tree seeds, as per statement under paragraph 793, say in all, ...				10	0	0
„ keeping clean nursery for one summer, . . .				85	0	0
„ expense of collecting manures, ...				10	0	0
„ corn seed for sowing 7 acres of compartments No. 10, .				5	0	0
„ rent of 26 acres of nursery ground for two years, say at 30s. per acre, ...				78	0	0
„ interest on rent for the first year, and which was not entered into the former account of expenses, at 5 per cent, .				1	19	0
„ Do. on sum outstanding at the end of the former year, at 5 per cent, ...				36	16	0
				£1693	8	10
Deduct from this value of grain crop on 7 acres of No. 10, say at £10 per acre, . . .	£70	0	0			
Do. value of 59,000 hardwoods, now supposed to be ready to plant out, at 25s. per 1000,	73	15	0			
Carry forward, .	£143	15	0	£1693	8	10

Brought forward, .	£143 15 0	£1693 8 10
Deduct value of 780,000 2-year seedling, one year transplanted larch, now ready to go out, say at 12s. per thousand, . . .	468 0 0	
Do. value of 300,000 2-year seedling pine, one year transplanted, at 6s. per 1000, .	90 0 0	
		701 15 0
Sum outstanding at the end of the second year of the nursery, or say at November 1861, . . .		£991 13 10

851. From the foregoing statement—and it may be taken as pretty near the truth, as it is founded on our own experience in similar cases—it will be seen that the entire sum outstanding on the establishment at the end of the second year is £991, 13s. 10d., after deducting the value of the crops ready to be removed from it, and leaving in the nursery all the other transplanted trees, as well as the seedlings that will now fall to be accounted for, which it is understood will have grown on compartment No. 8. In fact, were the whole stock of such an establishment to be sold, even at the time now referred to—at the end of the second year of its establishment—I have no doubt it would pay the proprietor all the outlay made on it. This of itself is an encouragement to extensive landed proprietors, who intend planting largely, to avail themselves of rearing their stock of plants on their own estates. But this is not all the advantage to be derived from such an establishment. It is a well-known fact, that trees nursed and grown upon a district are always more certain to succeed well than when grown upon a distant part of the county, and brought in for planting.

852. The same modes of the different operations of planting and sowing in the nursery are continued year after year successively, as long as trees are wanted to supply the demand for planting out upon the forest lands. Supposing that the hardwoods have been cleared, during the winter of 1861, from compartment No. 3, the larch from those numbered 5, 5, 5, and the Scots pine from the one No. 7, and all planted out into the enclosures suited for them—giving in all seven acres one rood cleared of the nursery ground—this extent is to be again put under green crop the spring following, or in the summer of 1862, preparative for being again planted with the same sorts of trees the year after, or in 1863; while, on the other hand, the five compartments numbered 10 are to be planted with the young seedlings that are now supposed to be raised on compartment No. 8, in the autumn of 1861 and spring of 1862, in every respect in the same proportions and in the same way as has been already described for the different sorts; and the seeds for crop 1862 may be sown in any part of compartment No. 10 that may be considered convenient for the purpose. In planting and sowing, attention should always be had to the proper sub-

dividing of the compartments, as, if this be not attended to, the business of the nursery would become much confused. I need hardly make the remark, as it seems evident at a glance at the diagram, that the hardwoods on compartment No. 2 are to go out in the autumn of 1862, and the larch and pine on compartments 4 and 6 as well; and that in this way, and from the planting out of the requisite number of seedlings of each kind each year, the regularity of the supply is proposed to be kept up, the one crop succeeding the other.

853. Having now stated all that I think necessary to say on the subject of nursery management—and these remarks on it are merely meant for the guidance of private foresters, and not to instruct public nurserymen in their profession—I shall conclude by giving a few general suggestions on the head.

1st. The regular rotation of the crops should be paid especial attention to, as, if not, and two successive crops of trees are taken from the same compartment without a green crop intervening, the trees of the second crop would be much inferior, not only in appearance, but in vigour of natural constitution. This, therefore, ought to be prominently kept in view by the forester. The carrying out of this is one of the simplest things possible, as all that is necessary is that each year, as the different classes of young trees are ready to go out, the land from which they have just been cleared should be subjected to a deep digging, and put under green crop the summer afterwards, preparative to being planted again the next year.

2d. The portion which is intended to be sown with the tree seeds should be deeply dug the autumn before, and allowed to lie exposed to the action of the weather till spring, when it will have become much improved and in better condition for the healthy vegetation of the seeds.

3d. The workpeople, in cleaning betwixt the rows of young trees, are very apt to injure the stems with their hoes and rakes. The forester should therefore see that the rows are not planted closer than has been specified, and that the people who may be employed in the cleaning are careful not to injure any of the trees in the way stated.

4th. In the lifting of the different crops of young trees from the nursery, the greatest care should be taken to do so with all their fibres uninjured, and rather with a small portion of the soil attached to them than otherwise. No shaking and tossing about of the plants should be allowed as they are lifted, as such usage always tends to injure their vitality, and consequently their growth afterwards.

5th, The plants should not be lifted from the compartments in large quantities at once, but only as they are required for planting out, as when they lie long in the sheugh their fibres become injured; and in removing the plants from the nursery to the forest or plantations, they should be tied up in convenient bundles, and stowed carefully in hampers or mats, out of which they should be emptied after being carried to the ground on which they are to be planted.

SECTION IX.—MANNER OF PROCEEDING WITH PLANTING OPERATIONS.

854. In all planting of young forest trees, the superintendent of such operations should be a man who has had considerable practical experience in that line of work. Unless he has had such experience, and that rather upon an extensive scale, he will not be able to judge for himself in any extraordinary contingency. A man who is allowed to undertake planting operations without proper practical experience is generally put out of his way by every change of the weather, and then knows not how to proceed. In such extremities he seeks the advice of others, who very likely are as ignorant in the matter as he is himself; consequently, the mind of an inexperienced man is liable to give in to wrong advice, and then the whole work goes wrong; time is lost, the work is badly done, and, in the end, failure is the sure result. This state of things, I am aware, often happens in planting operations; therefore, for the guidance of those who may not have experience enough, I shall here lay down, in a particular manner, the way of proceeding with planting operations as they ought to be done.

855. All land intended for the growing of young forest trees, if at all wet, should be drained at least four months before commencing to plant upon it; and indeed, if the land to be planted is of a very stiff and cold nature, and has been under a crop of trees formerly, I would advise to have it drained twelve months before planting. By using such a precaution, the ground will be considerably cleansed from any bad quality it may contain, and consequently the success will be much greater. If the land to be planted has been under a crop of trees formerly, and the roots of these are still in the ground, and if hardwood is to be planted upon it, have the pits for them made at least three months before planting. Indeed, for my own part, I am always anxious to allow the pits made for hardwood plants in such land to lie all the previous winter, in order to have the soil cleansed by the action of the frosts; that is to say, when I plant hardwood trees upon land formerly under wood, I have the pits all made by the month of November, and allow them to remain open till the month of March, when I plant the young trees in them. If, however, the land to be planted be

what is generally termed *new*—that is, if it have not been under a crop of trees before—the pits for the hardwood plants may be made at any time as the work goes on. In all cases where the surface soil is thin—say not more than six inches deep—and where the subsoil is of a hard tilly nature, and drains upon it are found not to act in so decided a manner as to draw off the water that may fall into the pits after they have been made, do not make the pits for the hardwood deeper than the top of the subsoil; for if they are made into the subsoil, the water will be retained there in the bottom of the pits, and will most assuredly tend to keep the roots damp, and retard the future progress of the trees. In such a case, make the pits only as deep as the bottom of the upper stratum of soil; and in the act of planting the trees, if the pit be found not deep enough, the earth can be raised sufficiently round the roots upon the surface: by using these means, the trees will be preserved in much better health than they would otherwise have enjoyed, and from the action of the drains, the subsoil will gradually improve, as the trees require depth for the descent of their young roots.

856. The above observations should all be in view by every intelligent planter previous to commencing planting operations. The not attending to these very plain and necessary precautions is the cause of very many failures among planters of the present time. Therefore I most earnestly recommend to every planter who wishes to excel, to go over his ground at least one year before commencing operations upon it, and lay down rules for the work, and proceed with them accordingly, and not to let the work stand till the very week when operations should commence, as is too often done. However, the forester is not always to blame in such cases of neglect. I have myself known active and intelligent foresters who were not allowed time and money to go on with their plans. This is to be regretted, because it is in the end a decided loss to the proprietor himself. In all cases where a forester is known to be really an intelligent man, and acquainted with his business, the proprietor should give him proper opportunity for doing his work in the best possible manner. By so doing, the proprietor will be amply rewarded himself, and the forester have credit from his operations.

857. Then, allowing that all the precautions above stated have been strictly observed, and that the drains have been allowed to act for a proper time upon the land, the person who is to take the management of the work will first consider the nature of the situation he is about to plant upon, which we shall suppose to be an extensive piece of moor-ground containing several varieties of soil. This being the case, he will next begin upon one side of the ground, and take observations as to the kinds and quantities of trees he will require for each particular part, supposing it naturally

divided into thin heathy ground, with high exposure—good loamy soil, upon a slope—moss two feet deep, resting upon clay—deep moss, but well dried—strong clay soil, upon a level—light sandy soil, resting upon gravel—bare rocky parts, with here and there good dry loam. Supposing that the ground to be planted contains all the varieties of soil above mentioned, the manager of the work will consider as to the quantity of ground contained in each of the divisions; and having ascertained this either by measurement or by the eye, according as he may find himself qualified, he will put up a *pin*, with a number upon it, in the centre of each district, and enter a corresponding number in his note-book, thus :—

858. No. 1.—Twenty-seven imperial acres of thin heathy ground, to be planted with Scots pine and larch, one-year transplanted, of each an equal number, and at three and a half feet apart.

No. 2.—Ten acres of good loamy soil upon a sheltered slope, to be planted with one hundred and eight oak, and three hundred and twenty-seven ash, to the acre, and made up to three and a half feet with one-year transplanted larch, and two-year transplanted Scots pines, of each an equal number.

No. 3.—Twelve acres of moss, two feet deep, resting upon clay, to be planted same as No. 2.

No. 4.—Twenty-four acres of deep moss, well dried, to be all planted with two-year transplanted Scots pine and spruce firs, at three and a half feet apart, of each an equal number, excepting three acres in the centre, which cannot be well got dried, and which must be planted entirely with alders, at four feet apart.

No. 5.—Thirty acres of strong clay loam upon a level, to be planted with three hundred oaks to the acre, and made up with equal numbers of two-year transplanted larch and Scots pines, to four feet apart over all.

No. 6.—Seventeen acres of light sandy soil, resting upon gravel, to be planted with two hundred and twenty beech, and two hundred and twenty birch eighteen inches high, to the acre, and made up to three and a half feet over all with one-year transplanted larch and Scots pines, of each an equal number.

No. 7.—Forty-three acres of bare rocky ground, with here and there spots of good loamy soil to the extent of six acres in all—bare rocky ground to be planted with eight-inch birch, two-year seedling larch, and Scots pines, of each an equal number to the acre, making them stand three feet plant from plant; good loamy soil to be planted with ash, at ten feet apart, and made up with Scots pine and larch to three and a half feet over all.

859. Now, supposing that the person who is to take charge of the planting of such a piece of ground has gone over it, and marked very particularly in his note-book the different natures of the soil in it, and stated the kinds of plants that he considers will be most likely to do good upon it, as I have above stated, and which is my own manner of going to work, he will, when he goes home in the evening, sit down and draw up a statement as to the number of each kind of tree he will require to have brought forward for the planting of each of the districts as numbered. In order to assist him in this calculation, the following table will be found most useful. Indeed, such a table is not only useful to a young and inexperienced forester;

it is as useful to the man of fifty years' experience as to one of five, because no forester can keep in his memory the number of plants he may require at a given distance per acre, nor can he at all times find it a convenient matter to calculate these numbers. In order, therefore, to save time, and to form a sort of ready-reckoner for the forester, I insert the following table:—

860. TABLE SHOWING THE NUMBER OF TREES THAT CAN BE PLANTED ON AN ACRE, WHETHER THE IMPERIAL, THE SCOTTISH, OR THE IRISH ACRE, FROM 1 FOOT TO 30 FEET DISTANCE PLANT FROM PLANT.

IMPERIAL ACRE.				SCOTTISH ACRE.				IRISH ACRE.			
Distance.	Number.	Distance.	Number.	Distance.	Number.	Distance.	Number.	Distance.	Number.	Distance.	Number.
1	43,560	12	302	1	54,760	12	380	1	70,560	12	490
1½	19,360	12½	270	1½	24,338	12½	350	1½	31,360	12½	452
2	10,890	13	257	2	13,690	13	324	2	17,640	13	417
2½	6,970	13½	239	2½	8,761	13½	300	2½	11,209	13½	385
3	4,840	14	222	3	6,084	14	279	3	7,840	14	360
3½	3,556	14½	207	3½	4,470	14½	260	3½	5,760	14½	335
4	2,722	15	193	4	3,422	15	243	4	4,410	15	316
4½	2,151	15½	181	4½	2,704	15½	228	4½	3,484	15½	292
5	1,742	16	170	5	2,190	16	214	5	2,822	16	275
5½	1,440	16½	164	5½	1,810	16½	201	5½	2,332	16½	260
6	1,210	17	150	6	1,521	17	189	6	1,960	17	244
6½	1,031	17½	142	6½	1,296	17½	178	6½	1,670	17½	234
7	889	18	134	7	1,117	18	169	7	1,440	18	217
7½	774	18½	127	7½	973	18½	160	7½	1,254	18½	206
8	680	19	120	8	855	19	151	8	1,102	19	195
8½	603	19½	114	8½	758	19½	143	8½	976	19½	185
9	537	20	108	9	675	20	137	9	871	20	176
9½	482	22	90	9½	606	22	113	9½	782	22	146
10	435	24	75	10	547	24	95	10	705	24	123
10½	395	26	64	10½	496	26	81	10½	640	26	105
11	360	28	55	11	452	28	70	11	583	28	90
11½	329	30	48	11½	414	30	60	11½	533	30	79

861. Before proceeding further, it may be proper to give a slight explanation of the above table. If, for example, the forester wish to ascertain how

many trees will be required to plant one Imperial acre at three feet apart, he will first cast his eye to 3 in the left-hand line of figures, headed *distance*, and under Imperial measure, from which figure he will next cast his eye to the right, and in the second line of figures, exactly opposite, he will find 4840, which is the number of plants required to plant an Imperial acre at three feet plant from plant. If he wish to ascertain the number required for any other distance, he has only to go upon the same principle, always looking first for the distance required in the left-hand line of figures. If it is desired to know the number needed for a Scottish acre, let him look for the number under that measure instead of under Imperial; and if for the Irish measure, it is only necessary to examine under that heading in the same way. Having given the table, I shall now point out the manner of drawing up the statement mentioned above.

862. STATEMENT OF THE NUMBERS AND KINDS OF YOUNG TREES REQUIRED TO PLANT THE DIFFERENT DISTRICTS IN —— PLANTATION, UPON THE ESTATE OF ——, 1860.

DISTRICTS.	Imperial acres in each.	NUMBER AND KINDS OF TREES REQUIRED.								Total Number of Trees.
		Larch.	Scots Pines.	Spruce Fir.	Oak.	Ash.	Birch.	Beech.	Alder.	
1	27	48,006	48,006	...	...	...	...	...	...	96,012
2	10	15,605	15,605	...	1,080	3,270	...	...	...	35,560
3	12	18,726	18,726	...	1,296	3,924	...	...	...	42,672
4	24	...	37,338	37,338	...	...	...	...	8,166	82,842
5	30	36,330	36,330	...	9,000	...	...	...	...	81,660
6	17	26,486	26,486	...	...	...	3,740	3,740	...	60,452
7	43	69,056	69,056	...	...	2,610	59,693	...	...	200,415
	163	214,209	251,547	37,338	11,376	9,804	63,740	3,740	8,166	599,613

It may be necessary for me to give a little explanation of the above statement. In order to this, we will look over District 2. Upon looking back to particulars on the second district, as they were supposed to be taken upon the ground, it will be seen that it contains ten acres, which number is stated in the second column from the left hand in the above table. Next, it was to be planted with 108 oaks and 327 ash to the acre. Now, if we multiply these numbers by 10, for the number of acres, we will have 1080 oaks and 3270 ash for the whole district, which is stated, accordingly, under oak and ash upon the same line as formerly stated. Again, the particulars state that the ground was to be made up to three and a half feet with 1-year transplanted larches and 2-year transplanted Scots pines, of each an equal number. Now, if we look at the table of distances formerly given, we shall find that, in order to plant one imperial acre with trees at three and a half feet apart 3556, are required; but as we have already allowed 435 hardwood to the acre, this quantity must be deducted from the 3556, consequently leaving 3121 nurses for the acre to be planted among the hardwood; and as the nurses are to be larch and Scots pines, of each an equal number per acre, we must take the half of the last number given for each sort—that is, 1560½ of each for the acre. Now, there being 10 acres of ground to plant in this instance, we must multiply the last number by 10, and the gross amount of each sort of nurses required will be 15,605, which will be found to correspond with the numbers stated under larch and Scots pines upon the line No. 2. In the same manner all the other districts are described; and in the summing up of the whole it will be at once seen, that in order to plant the whole 163 acres, the forester will require to bring forward to the ground 599,613 young trees, of the various kinds stated in their respective places.

863. Presuming now that the person in charge of the work of planting has looked over the ground, and has put up a pin in the centre of each district to correspond with the number entered in his statement, and that he has drawn out such a statement as I have shown above, for his future guidance in the work, he will next order the plants to be brought forward and *sheughed*, each district having the quantity of trees adapted for it put by themselves; that is, in order to plant No. 2 in the manner proposed, there will require to be sheughed in it 15,605 one-year transplanted larches, and the same number of two-year transplanted Scots pines, with 1080 oaks, and 3270 ash; and so with each of the others. Great care is requisite, in bringing forward the young trees, to see that it is done in a fresh day, and when there is a little moisture, if possible; and if the plants have to be carted far from the nurseries, all their roots should be covered with matting during the journey, to prevent the air from having any bad effect upon them. As soon as the cart arrives, a deep dry part of the ground must be chosen for sheughing or laying them in. This requires to be done in a very careful manner, avoiding too many hands being employed on the work at once. If those points are not strictly attended to, there will be a great chance of failure in the results of the work. I have frequently, when assistant-forester, seen shameful carelessness practised in regard to what I am now recommending; and this is the very reason that makes me so urgent in recommending carefulness where it is wished to have success in the work of planting.

864. In sheughing the young trees, take out a trench deep enough to hold the

roots easily, and put the turf and earth which is taken out of it all along upon that side of it which is meant to be the outside when the work is done. On having this earth levelled along the back or outside of the opening, if it is the hardwood trees you intend to put in first, you may do so without loosening the bundles (as I presume the plants will be tied up in bundles), as they are not apt to spoil although they lie a time in the ground in a crowded state; but if the plants are firs or pines, have the bundles opened out, and the plants spread out upon the side of the trench not more than two inches thick. When the whole length of the trench is filled with the plants, whether hardwood, pine, or larch, put the finest of the earth from the next trench on their roots, and make up above that with a sufficient quantity of soil to cover the roots of all the plants laid in, as well as to make another sufficient opening for another row. When the roots are thus sufficiently covered, give the whole a firm tramping, in order to keep out frosty winds the more securely. Then, immediately after this tramping, gather up in your spade any fine earth in the bottom of the trench which is to receive the next row, and fill up with it any open parts about the necks of the plants in the line put in, in order that no spaces may be left for the air to get down to the roots. After re-levelling the surface of fresh earth which is tramped above the roots, the front of the new trench may be lined off, and filled up as before. Many planters are very careless about this part of the work, and sheugh in the plants in a mere temporary manner; but I would caution every forester who wishes to excel in the work of planting against such a manner of procedure, and urge him in all cases to put his plants into the earth in a manner as permanent as if he knew they were to remain for months. I have myself seen young trees sheughed in a temporary manner, the planter supposing that they would be all planted out in the ground in their places in the course of a day or two; but instead of this expectation of his being realised, frost set in, and snow followed. The trees lay in the sheugh in the same temporary state they had been put in at least two months. When the weather broke up, the forester who had the management of the work persisted in planting them, and, as I anticipated, not more than a hundred trees to the acre were found alive in the summer. I mention this here, in order that others, being aware of the fact, may in future guard against such a manner of going to work, which is not only discreditable to any forester, but, what is worse, ruinous to the proprietor. In the same manner as I have described for the securing of the trees in No. 2, let the trees belonging to the other districts be done also, care being in all cases taken to have them sheughed in a piece of dry soil, and where water is not apt to lie in the bottom of the trench.

865. The young trees being all brought forward and sheughed in their respective places, the superintendent of operations will next consider as to the number of men he may require for executing the work. In this case he had better select a few good hands, and have the work done properly, than gather together a number of bad ones, who perhaps never had planted a tree before, and who may very likely be regardless how the work may be done, provided they receive their daily wages. As to the number of men that will be required to do the work in a given time, we shall suppose that the planting is to be commenced about the 1st of February, and that the forester, on account of having other plantations to make the same season, is anxious to have the plantation in question—that is, the 163 acres referred to above—finished in the course of four weeks. There are thus 163 acres to be planted in four weeks; and as at that season of year it is more than likely that a portion of the time will be broken upon by bad weather, therefore, in order to have the work finished, if possible, by the time specified, instead of calculating that it is to be done in twenty-four days, we must deduct a portion, and say that the work is to be done in twenty-two days. We have thus 599,613 plants to put into the ground in twenty-two days. By the system of notching, I generally calculate that a man in a short winter day, working from eight in the morning to four in the afternoon, and allowing one hour for rest, should plant one thousand young trees with ease, and at the same time do his work well. Let it be understood, that if a man is much hurried at his work, he cannot do it well: the superintendent should, therefore, keep in view not to hurry his men unreasonably, but to make them give a fair conscientious day's work—as, by so doing, he will have his work much better done than if he acted otherwise. As this work is to be done in the month of February, when the men, instead of working from eight to four, can work from seven to five, they will be able, with the assistance of a boy each, to plant 1300 plants each. Now, if we divide 599,613, the number of trees to be planted, by 1300, the number that a man can plant in a day, we will find that, in order to plant the whole with one man, he would require 461 days; but if we employ twenty men, they will, at the rate of 1300 a-day each, plant altogether, in one day, 26,000 trees; and, if we divide 599,613, the number of trees to be planted in all, we will find the answer to be twenty-two and a-half days nearly; therefore, in order to finish the work in about twenty-two days, twenty men will be required to plant at once. As, however, there will be pits to make for the oak, ash, and beech, and the planting of these will take more time than the others, it is necessary to calculate upon them as extra, even allowing that we have already included the number of hardwoods among the other trees. By looking at the state-

ment containing the number of trees to be planted, it will be seen that there are 24,920 oak, ash, and beech; and these require to be planted in pits. Now, in order to plant these in twenty-two days, we must calculate thus:—one man will, in a moderate soil, where no picking is required, make 1000 pits and plant them with hardwood in one week, being about 167 to a man in the day, and at this rate seven men will make pits and plant the hardwood trees in the same time that the twenty men will plant the others, which have to be notched; consequently, in order to have the whole work done in twenty-two days, twenty-seven men will require to be employed. The superintendent, after making a calculation of this nature, should, when the men begin work, keep a note of the number of the trees planted upon the first day, and compare the work actually done with his calculation. By doing so, he will be aware of how far he is likely to be correct in his plans in the future management of the work.

866. We shall now suppose that the superintendent has twenty-seven men looked out in order to commence work, and has given them orders to meet him on the ground at a certain time; and that he intends to commence by planting No. 1, being twenty-seven acres of thin heathy soil, not adapted for the growing of hardwood, to be planted with Scots pine and larch, three and one half feet apart, one year transplanted, of each sort an equal number. We shall further suppose that the superintendent is forward on the ground on the morning appointed before any of his men are collected, which ought always to be the case; for if he be a man of an indolent habit in the morning, the men will very likely prove the same, and consequently the work will not go on in a prosperous manner, and there will be small hopes of getting through it in due time.

867. Being then thus forward, he will arrange in his own mind quietly as to the work to be done for the day. If it have the appearance of being a fine one, he will put the men to plant upon the most exposed parts of the grounds; and if otherwise, upon the most sheltered parts. The superintendent should provide himself with three or four poles, such as farmers generally use for straightening and measuring off their furrows; and while the men are collecting, and before it is light enough for them to plant with propriety, he will begin upon one side of the ground to be planted for the day, and pace off, from the side at which it is intended to begin, about three yards in breadth for each man to be employed upon, making in all, for the twenty-seven men, about eighty-one paces or yards. At the end of that distance from the outside he will put up one of his poles as a guide for the innermost man to keep by in the act of planting; and in the same manner he will mark off the whole length of the ground by one or two more poles before the men commence.

The poles being set to the breadth required, he will next see that each of his men has provided himself with a stout boy or a girl for handing the young trees, and that each of these has brought a stout apron for holding them, in order to protect their roots from the wind, as well as to keep them together while he takes out one at a time with his right hand. Being satisfied of this, he will next examine the sort of spades the men have brought to work with. So far as my experience has enabled me to judge, there is, for the purpose of notching, no implement so useful as a half-worn common garden-spade; and for this purpose I always prefer one with the blade from eight to nine inches in length. In all notching of trees, therefore, I make every man bring along with him such a spade as I have described, never allowing any man to plant with a new one, as I have found from experience that the man who uses a new one cannot plant the trees nearly so well, nor can he plant nearly so many in a day, as he would do with a half-worn, sharp-edged spade. However, those who may not be satisfied with using old spades as I am in the habit of doing, will find an excellent article, made for the purpose of planting young forest trees, in any nurseryman's warehouse. These are termed *planting spades.* They are of the same form as a common garden-spade, but smaller in the blade, and having the *shears,* or that iron part which clasps the wooden handle, made stronger than in the common garden-spade, in order to resist the more certainly the strong pressure which is sometimes put upon the handle in the act of notching upon the tough turf.

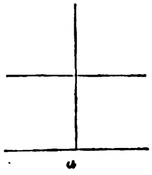
In cases of necessity I sometimes use these planting-spades; that is, when I cannot procure enough of half-worn ones for the number of men that I may have occasion to employ; but in all cases I have observed that those of the men who have common spades do far more work in a given time than those who use the planting-spades; the reason being, that those tools are made too heavy in the iron, and, when new, are not so pliable in a man's hand as a sharp old spade.

868. The superintendent being perfectly satisfied as to the good state of all the things above mentioned, he will cause some old trustworthy man to take charge of the plants that have been sheughed, whose duty it will be to give out to the boys the different sorts of young trees as they require them. This must not be trusted to the boys themselves, as they would most likely shake the earth from the roots of the plants when they came to take away a quantity; and, besides, they could not judge themselves as to the quantity required to be taken at one time. Having appointed an old man for this purpose, the superintendent will send the boys to him to where the plants are, and cause them to bring with them in their aprons, each, as nearly as possible, fifty larch and fifty Scots pine, with their roots laid in-

wards; that is, the old man will take fifty plants of larch and place them in the boy's apron, say upon the left side, with their tops out and their roots inwards, and he will also take fifty Scots pine and place them in the same apron upon the right side in the same position. This precaution is necessary, in order to protect the roots from the winds and drought. It is not necessary that the man should count every plant he puts out; but if he count a few times, he will very soon, from practice, be able to give the boys the desired number, always observing in the present case to give larch and Scots pine of each an equal number. This he will do every time the boys come to him for a supply as their former quantity is done: fifty plants of each at once make a very good quantity.

869. The men, with each a young person and plants, being all arranged in a line upon the edge of the ground to be planted, having their backs towards the plantation ground, and their faces looking upon the fence or boundary from which they are to start, and each having a space of three yards in breadth to plant, the superintendent will, with his own hands, take a spade and show them how he wishes the trees to be planted, and also the manner of keeping the distances of one tree from another; at the same time he will show the boys how to put the tree into the notch as it is opened by the man. I may here explain the manner of planting by the system of notching, and how the boys ought to put in the plants. The operator, with his spade, makes two deep cuts upon the turf, crossing at right angles exactly where the plant is to be put in. (See Fig. 120.) He next inserts his spade across one of the ends of the four rays, as at *a*, which may be about five or six inches from the centre—this insertion of the spade being made on the side next himself. When the spade is inserted at *a*, he bends the handle or head of the spade towards himself, and nearly to the ground. At this stage of the operation the turf will open in the centre of the cross in four equal parts, but most from the point *a*; and at this instant the boy inserts his plant at the point *a*, where the spade intersects the ray from the centre. Immediately on inserting the plant he will draw it to the centre, while the planter will retain his spade for a moment until the boy has the roots rightly adjusted after passing them through the cut. As soon as this is done, the operator raises up the handle of his spade, letting the earth and turf down upon the roots of the plant, and makes all the cuts close and compact about it by tramping with the fore-foot first, and then with the heel. If the cuts do not close tightly, as is sometimes the case when the turf is of a hard benty nature, a little piece of thin turf may be taken from the open space and placed over the cut,

FIG. 120.



which will keep out the drought, this also getting a tramp with the foot. When the situation to be planted by notching is upon a sloping brae, the operator should stand with his back up the hill and his face looking down. By doing so, he inserts his spade for the opening of the turf at right angles with the rise of the ground upon the upper side; and in this case the water coming along the surface is intercepted by the cuts, and retained for the advantage of the young trees. Another point to attend to in the planting of young trees by notching, is to see that they are not inserted too deeply, for this is an error in planting which very often takes place. In order to avoid this, which is against the health of the plants, the boy should be instructed to hold the young tree between his fore-finger and thumb, just about one inch above where the earth has been formerly. When he puts it into the cut, he should hold it firmly by that part until the turf falls down in its place; and if he finds that the turf, when down, is much above the points of his finger and thumb, he must pull it up a little, so as to have these resting upon the surface of the turf. By attending to this precaution, the young trees will have a better chance to succeed well. I have frequently seen the boys left to make the plants firm in their place; but this should never be allowed by any man who wishes to do anything like his duty to his employer. I have also known foresters who were so stupid and foolish as to make the men and boys hurry on and get the plants put into the ground at all events, not paying the least attention as to the manner in which the work was done; boasting then to their employers as to how many plants they had put in in one day, and of the low price at which they could plant an acre of ground; and all this with the view of deceiving their employer and gaining his favour in the mean time. But, as was the natural result, the crop was a failure. Every forester who wishes to do well to himself, and to his employer at the same time, should have his planting work executed well, without paying respect to a few extra shillings of outlay on the acre. The work, when well done, will prove satisfactory to the proprietor afterwards, as well as to himself; and I again urge the making every man employed in the work of planting accountable for the planting of the trees in a proper manner, and not the boys.

870. The superintendent will now see that his men go on according to the instructions given them, which are in the mean time supposed to be as above; while he also takes care that they cause the boys to mix the larch and Scots pine equally upon the ground; that is to say, that the boys put in one larch and one Scots pine alternately, mixing them in equal numbers as nearly as possible, and as near to the given distance as can be guessed—that is, in the present instance, *three and one half feet.* With regard to this point, I have generally found that men are more apt to plant a few more

trees per acre than otherwise. After the men had done planting a piece of ground, I have measured off an acre, and counted the plants upon it, and have found two hundred more than the stated allowance. Upon exposed situations, however, this is the surer way of going to work ; for a few trees extra per acre are always easily thinned out in due time, but a blank is always an eyesore in any plantation ground, and this can scarcely fail to be the case if a plantation is left thin at first.

871. The men being now, as we will suppose, going on briskly with their work, the superintendent will keep a sharp look out behind them, to see that they do the work according to his directions given to them when they commenced. If there be any hands among them who are more stupid than others, he will look most sharply after them, and leave more to themselves those whom he knows to be well acquainted with the work. He must go backwards and forwards among the planters, minutely examining their work; in short, he must examine almost each tree as it is put into the ground, and see that it is properly planted and made firm in the ground. When the least fault is observable, it ought to be checked at once, and the fault laid to the person who did it; and if he persist in doing the same thing over again, the better way is to pay him off at once rather than run the risk of having the work badly done. An example will thus be made among the men, showing them that the orders of the superintendent must not be trifled with. Every cut made with the spade in the act of planting a tree should be firmly closed, in order to prevent the drought from taking effect upon the roots.

872. When any boy has his supply of plants nearly finished—say all but ten of each sort—he will give these to the man whose assistant he is, and run for a fresh supply while the man is planting them. By this method no time is lost; and as the supply of plants is generally not far off, and the old man ready to give them out, any boy may be back with a fresh supply before the man has twenty planted. Some planters have one boy serving the others with plants ; but this method I have found objectionable, seeing the plants are more exposed by it.

873. When the planters have arrived at the other end of the ground laid off for them by the poles, the superintendent will, from the pole at which they ended, measure off another space of the same description as the first, and cause the men to fall in upon it, and plant backwards another breadth of land, ending at where they commenced. In order that the men may not be hindered, the superintendent should have the land measured off previous to their finishing the first piece, and make the pole at which the men end the last to be removed, and the first to begin at again. By going to work in this manner, the superintendent is on the spot to see his men

fall into their proper places again upon the new land; and thus the planters will cross and recross the ground until they have the district finished. When there may be any odd corners to finish, upon which the whole number of men could not be profitably employed at once, the superintendent should cause a few of his most trustworthy hands to finish them, and carry off the others himself to commence upon another district.

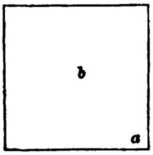
874. At any time when the day may turn out wet, if the men have all collected, and are willing to work, let them do so, but only as long as the ground is not saturated with rain, which can at once be known by the young trees not firming in the ground. As soon as the superintendent sees that the men cannot, with the usual beating, firm the trees, let him give orders to drop work at once: to persevere in such a state of things is the worst management. However, upon dry ground this will seldom occur. If the day should prove frosty, let the men be set to make pits in any district of the ground where it is required to have them—an operation which, in new land, should always be left for days of this nature; but the superintendent should be most careful never to allow a tree to be planted in such pits till the frost has been properly thawed out of the earth. To plant a young tree among frozen earth will kill it as certainly as if it had been put into boiling water; therefore the planter should always be extremely careful to avoid this.

875. It sometimes happens that a morning will be frosty, and yet the day prove good for planting operations after the sun has reached a certain height. In a case of this kind, the superintendent ought to set his men to the working of pits for hardwood in the mornings, till the sun gets well up, and the frost has abated. This he will at once know by the fresh earth which has been turned out of the pits in the morning. If the particles of it are crumbly on the top, and rather dry, the frost is too keen to admit of planting with safety; but if they are, when handled, of a soft and pliable texture, he may proceed with planting immediately. In the afternoon, when the sun begins to get low, he must observe the same precautions: as soon as the earth, from its crumbling dryness, begins to indicate the presence of frost, he must leave off the planting, and resume the work of making pits; but if the earth continue soft and pliable to the feel, he may go on with planting, whether in pits or by notching.

876. We shall now suppose that the planting of district No. 1 has been finished, and that the superintendent wishes to go on with the next district in succession, No. 2. This consists of ten acres of good loam upon a sheltered slope, and is to be planted with 108 oaks and 327 ash to the imperial acre, and to be made up with one-year transplanted larches and two-year transplanted Scots pines, to the distance of three and a half

feet over all. By looking at the table of distances given in this section, it will be observed that, in order to plant 435 hardwood upon the imperial acre, the pits will require to be made at distances as near ten feet as possible. Now, supposing that this has been partly done during a frosty morning, while planting the first district, the superintendent will, as is the most profitable way, and that by which he can always have the men most immediately under his notice, set all hands to fill up the pits which have been made with trees, and not put one party to the making of pits, and another to the planting of the trees, unless, indeed, he can put on one party to make the pits in whom he can place more than ordinary confidence, and enable him to devote his undivided attention to the planting. This I frequently do myself; but where the superintendent cannot place confidence in a certain party of his men, his better plan is, in order to have the work properly executed, and to have it carried on to advantage, to keep them all at one department of the work. This he must do as he finds himself circumstanced, because either of the ways will answer so far as the work itself is concerned. In planting the hardwood in the pits, the boys will not be able to carry about with them so many plants as they did of the pine and larch, the hardwood plants being larger; twenty-five of oak, and the same of ash, will, in the present case, be a fair proportion, and enough of trees at once.* In the act of planting in the pits, if the situation be an exposed one, I put the plant, not in the centre of the pit, as many do, but in one corner of it. (Fig. 121, *a*.) My object for doing so is to obviate the bad effects arising from the wind shaking young trees when first put in their place, as in exposed sites this is greatly prevented by planting the tree in the corner of the pit rather than in the centre. In the former position the young plant has two firm sides to rest upon instead of the open soil all around it, as is the case when planted in the centre, as at *b*. As to this, the superintendent must judge for himself, whether he ought to plant the one way or the other, and be regulated, in doing so, according as the trees are apt to be shaken or not by severe storms. Whatever way, however, may be resolved on, the boy holds the tree in its place until the man with his spade fills in all the loose earth taken out of the pit; the boy all the time moving the plant slightly up and down until he find the earth heavy about its roots. When the whole earth is in, the man should take hold of the plant, and judge if it is too deep: if so, he should pull it up a little, and then with his feet make the soil firm about the roots

FIG. 121.



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* In the case of planting the above mixture of oak and ash, the oak should be first put in at twenty feet apart, and the ash between them to ten feet alternately.

of the newly-inserted plant. As it is understood that, in the making of the pits, the turf, when taken off, was divided into two equal parts, the man will next take the divided turf and place it, grass undermost, upon the surface of the pit, with the tree in the centre, and make it quite firm and close about the plant. If, however, it is intended to plant the trees in the corners of the pits, it will not be necessary to divide the turf at all, but merely to turn it upside down upon the surface of the pit. The earth upon it should then be pared off, and put with care upon the joining all round, the whole receiving a firm beating from the feet. In the same manner proceed with the planting of all the trees in the pits ; and when it happens, at any time, that the men, on account of frost, are set to make pits altogether, the boys may be dispensed with for the time, the superintendent letting them know when to come back, provided the weather shall be fresh.

877. Some planters have recommended to plant the ground first with pine or larch nurses ; and where it is intended to plant hardwood among them, to do so when the nurses are from four to five feet high. This they say is in order to produce shelter for the hardwood previous to putting them in. I am decidedly against this system of rearing hardwood, being certain that no advantage is gained by such a method, but, on the contrary, there is much lost. For example, if oaks are either sown or planted among pines when these are from four to five feet high, they very soon overtop the oaks, and render them, if not useless, at least tall, slender, and unhealthy ; but so far as I have seen the effects of the system, the oak trees so dealt with are more generally found crushed down, unhealthy, and stunted ; this being always occasioned by the rapid growth of the pines as compared with that of the oak. In all high-lying situations, any hardwood that may be planted should be plants of a rather small size as compared with others that would answer in a sheltered place. These small plants, I have always found, are much improved by being cut over by the surface of the ground the beginning of the second year after being planted out : by this method of treatment they make fair shoots during the second summer of their standing in the forest ground. During the third summer, the young shoots are thinned out, and one left for the ultimate tree at each stock, when a fine young tree is formed, fresh and new, and in every respect adapted for the climate in which it has been produced. By this time also the pines are beginning to make rapid progress, and give the hardwood plants the benefit of their shelter, so that at eight years' growth, upon a high situation, the nurses will very probably be from six to eight feet high, and the young hardwood, if dealt with in the manner I recommend, will be at least five feet. Thus we have, by the method I recommend, when the nurses are from six to

eight feet high, good healthy hardwood, whether of oak or any others; whereas, by the method referred to above, the planter would be several years behind, besides running the risk of having his hardwoods choked and ruined, by the nurses being so much in advance of them.

878. The hardwood being all planted in the district No. 2, the superintendent will next proceed to have the ground filled up, to the distance formerly specified, with the larch and pine nurses, by the method of notching already described. District No. 3, containing twelve acres of moss resting upon clay, is to be dealt with in the same manner as the district last referred to. I have seen excellent oak timber upon a mossy surface soil resting upon clay, and that was when the moss had been well dried from superfluous moisture. When it is well drained, the moss has a rapid tendency to subside, and the roots soon find their way down into the clay, where they derive their principal nourishment. Indeed, upon a soil of this description, larch and Scots pines thrive well also.

879. District No. 4, being twenty-four acres of deep moss, but well dried by draining, will not grow hardwood to any advantage; unless, indeed, we may except ash, which will do well in moss as a coppice. In this case, however, I have advised to plant spruce fir and Scots pines, both thriving pretty well in a mossy soil: the spruce firs more particularly do well upon such a soil. These should all be planted by notching, unless the plants used be large, and the surface rough with strong grass, in which case they should be planted in pits; and particular care should be had to see that they are made firm, as the cuts in the moss are very apt to open when the drought sets in during the spring, which would be against the health of the plants. In a mossy soil, plants of any description never come away quickly. I have observed mossy tracts that had been planted in new plantations, make scarcely any progress whatever for the space of eight or ten years from the time of planting. This was occasioned by the want of stimulus in the soil to set them off in their growth, the moss being always what foresters term *dull;* but as soon as shelter is produced by other trees growing around the moss ground, the plants in it come away rapidly. In the centre of No. 4 there is a spot of three acres, which, from the difficulty of getting conveniently a sufficient fall for the water, is not well drained. In such a place the alder is the only crop which will succeed, and these may be planted by notching.

880. District No. 5, being thirty acres of strong clay loam upon a level, is excellently adapted for the growing of hardwood, and more particularly of oak; therefore I have recommended to plant three hundred of them to the acre, and make up to four feet over all with two years' transplanted larch and Scots pines, of each an equal number. In

this case, the oaks being upon a level part of the ground, and sheltered by rising ground in the neighbourhood, the plants may be inserted in the centres of the pits, and the larches, which here, on account of the strong herbage upon the ground, are to be two years transplanted, will, in order to have justice done them, require to be planted in small pits, merely the breadth of the spade upon the side of the square, which can be very quickly made. I have found that a man will make five hundred of such pits in a day upon a good pliable soil, such as that at present supposed: they need not be more than from seven to nine inches deep. The Scots pines, although two years transplanted, may, in a good clay soil, where there are no roots of old trees, be planted by the notching system, taking care to make them firm in the ground, and not to put them in too deep,—an evil with regard to coniferous trees of all kinds which should be particularly guarded against. The roots of all these trees, if buried out of the influence of the air, are sure to be thrown into bad health, or perhaps die, according to the degree of depth.

881. District No. 6, being seventeen acres of light sandy soil, with thin surface turf, and resting upon gravel, is to be planted with two hundred and twenty beech and two hundred and twenty birch to the acre, each sort eighteen inches high. These must be put into pits; but the soil being of an open free nature, these need not be large. Pits of the same size as has already been recommended for the larches in the last district, will answer perfectly well; and allowing four hundred and forty hardwood to the acre, the pits for them will require to be made about ten feet apart. These being put in, the ground is to be made up to three and a half feet over all, with one-year transplanted larch, and one-year transplanted Scots pine, of each an equal number. They may all be notched; and in putting them in, care should be taken to see that they are properly mixed, and larch planted next the hardwood.

882. District No. 7 consists of forty-three acres of bare rocky ground, with here and there spots of good loamy soil, to the extent of about six acres in all: the bare rocky ground to be planted with eight-inch birch, two-year seedling larch, and two-year seedling Scots pine, of each an equal number to the acre, making them stand three feet, plant from plant: the good loamy soil to be planted with ash, ten feet apart, and made up with larch and Scots pine to three and a half feet over all.

In this case, have first the six acres of good loamy soil made up with the desired number of trees to the acre; planting the hardwood first in pits, and then filling up the ground with the others, as already specified, by the notching system.

In planting the bare rocky parts with the two-year seedling larch and Scots pines, and also the birches, a system of planting, different from what we have yet mentioned, must be resorted to—namely, that of planting by means of the planting-mattock. (See Fig. 122.) The handle of this implement is generally made about forty inches long, and of a piece of good ash-wood: the mouth or cutting end *a*, is about four and a half inches broad, and pretty sharp; and the length of the one side, from the face to the eye, is about fifteen inches. The other side, instead of being broad and sharp, is made to taper to a point, as in the common pick (see *b*). In using this implement for the purpose of planting, which is only done upon thin, stony, or rocky ground, where the spade could not be used to advantage, the operator takes it into his hand in the same manner as he would do a common pick, and first pares off a thin part of the turf, with the broad end, *a*, exactly on the spot where he intends to plant a tree. Having this turf taken off—say about six inches square—he next with the pick-end loosens the soil in the spot pared, to the depth of about eight inches, bringing up at the same time to the surface any considerable-sized stone or stones that might interfere with the planting of the tree. In this manner any number of men may be employed, always observing to keep to the specified distance as nearly as circumstances will permit. In general, every two men employed with the planting-mattock are followed by one person having the trees in an apron, which he plants in the spots prepared. In planting with small seedlings, he uses an implement called the *planting hoe*, represented by Fig. 123. The iron part of this implement, from *a* to *b*, is generally about twelve inches long; the mouth or sharp end at *a*, is made about four inches broad, and is not kept so sharp as the mouth of the mattock, it having to be used in the earth; the handle may be about fifteen inches long. The person who is intrusted with the planting of the seedlings in the spots previously prepared by the men with the mattocks, carries his plants in an apron before him. In using the planting hoe, he keeps it in his right hand, and digs it into each spot; and by pulling it, when in, a little towards himself, he makes a sufficient opening at the back of it to hold the roots of the young tree, which he puts in with his left hand, inserting the roots very carefully. As soon as the roots are properly put in, he withdraws the instrument, taking care at the same time not to disturb the plant in its position. When the implement is out, he gives the earth, upon the side of the hole next to him, a push with its mouth, in order to hurl the loose earth into the hole about the roots of the newly inserted plant; and finishes by tramping and making the plant firm in its place. In this manner three men will plant nearly two thousand plants a-day.

FIG. 122.

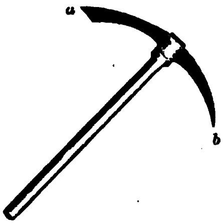
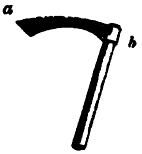


FIG. 123.



883. On very bare or rocky surfaces, it is not always even possible to get as much earth in a certain spot as will properly cover the roots of small seedling plants. Where this is the case, it is a better plan to sow the seed of the trees wished to grow in the ground at once; which is the only way of getting young trees to rise in certain districts. This plan has been adopted in some parts of the West Highlands of Scotland, and has been attended with good success.

884. We often see seedling trees, of almost every common variety, growing upon old walls, or any chink of a stone where the seed has only got a small portion of lime rubbish or other decomposed matter to vegetate in; and in this position we have seen them attain considerable dimensions, so much so as to rend the wall, in which they had got a footing, into pieces. Even in the crevices of rocks we often see trees of very large dimensions growing, which points out that, where a young tree can only obtain a very slight footing for fixing its roots, it will prosper ultimately, and make room for itself. I am strongly of opinion that many bare rocky parts of a country might, under proper management in growing the seeds of forest trees upon them, be made very productive and valuable, not only as a shelter to the surrounding country, but as yielding a profitable crop of timber. The oak and birch, in particular, are well adapted for this purpose. I have myself cut oak and birch coppice of valuable quality growing upon bare rock; and I am convinced, from what I have seen upon this point, that both these trees are well adapted for covering bare rocky ground;—the oak in moderately exposed, and birch in high and exposed, parts of the country. In sowing the seeds of either of these trees upon a bare rocky surface, it is necessary to have little patches prepared; and this can very easily be done by carting several loads of earth to where that does not previously exist in sufficient quantity. The acorns may be laid two or three in a shallow fissure of the stony ground, and merely covered by one spadeful of earth; and the birch seed may be sown upon the surface of a spadeful of earth laid down for the purpose, and merely get a slight beat with the back of the spade, in order to prevent them being blown away. Even Scots pine and larch seed may be sown in the same manner, but the oak and birch, being trees adapted for coppice-wood, are decidedly preferable for ground of the nature in question. Another reason for sowing the seeds of trees in poor, thin, rocky soil is, that there the seed is not very apt to be destroyed by mice, birds, and other vermin, they being in the habit of frequenting more favoured spots for the sake of cover and shelter.

In growing trees from the seed in such situations as that referred to, it is necessary to keep the patches clear from weeds for the first two years, and to thin out all the patches to one individual after the second year of their growth, at which stage the plants will be established in their place, and require no farther attention.

Having now stated pretty fully the method of proceeding with planting operations, I shall conclude with a few general observations.

885. In the planting of coniferous sorts among hardwood, it is of importance that the larch plants should as much as possible be kept next the hardwood. By this method of procedure, when the first course of thinning takes place, we shall have larch trees to sell instead of pines, which would not be the case were the pines planted next the hardwood; for in the first course of thinning it is always necessary to relieve the hardwood first by taking a few trees off them.

886. In making up with young trees old plantation ground upon which a number of large trees may be still growing, for the purpose of producing a clothed appearance until the young trees rise up, the spreading branches of such of them as may be covering a large piece of ground should be lopped off; for the young trees will not thrive under their branches. In planting young trees near old ones, it is always advisable to keep the young beyond the drip or outer points of the extended branches of the old; and as the young trees rise up, the old should be either cut away altogether, or their side branches so much shortened, as to give the young ones free room and space to rise up healthily.

887. In preparing old plantation ground for planting young trees upon it, the pits for the hardwood should be made three or four months previous to planting the trees in them. By using this precaution, the soil is made more healthy for the roots of the young trees, and they will consequently come away much better. Young trees planted in ground from which a crop of wood has been lately taken, seldom come away so freely and quickly as trees planted upon a fresh soil, and this more particularly if the crop is not changed. On this point it may be necessary to give a few more practical hints, for many foresters are liable to error in this point, and I have seen many failures take place in consequence.

It is now a well-ascertained fact among the more observing and intelligent foresters, that in the culture of trees, as well as in the culture of any agricultural or horticultural plant, a change of crop, or a rotation of cropping, is necessary upon the land; and in many instances where this has not been attended to, a failure has been the result. However, there are modifications as to the extent of the failure in cases of this nature; this depending upon the adaptation of the land to the nature of the trees cultivated. For example, if a piece of land, upon which pines or firs have been grown to full size, be of a rather deep sandy loam, another crop of the same species may be taken, and the trees of the second crop may very likely prove nearly as good as those of the first. But if a piece of land, upon which these roots have been grown to full size, be thin in the upper stratum, with a hard tilly subsoil, the second crop will not succeed so well; while, on the other hand, from the upper stratum having been greatly enriched by the fall of their foliage, the hardwood trees would succeed; and after they had got themselves established in the upper soil, and had gained strength, they would send down their roots deep into the subsoil, and improve it to a great extent. After the hardwood crop had been perfected and cut down, and the soil in the upper surface had been improved by the foliage of the hardwood rotting upon it, a crop of pines would thrive well upon it again, and in all probability would be much better than the first crop; because, the soil being now much deeper than at first, and improved by the penetration of the roots of the hardwood, the roots of the pines would have a renewed soil to grow in: the one crop thus preparing the soil for the reception of another, as is well known to be the case in all agricultural rotations of cropping.

888. But although firs and pines will not grow to the same state of perfection when planted successively upon the same piece of land, excepting always those grown on soils of the granite formation, on which there seems to be no limit to their successive crops—they will, notwithstanding, grow to a considerable size, and even to the extent of becoming useful timber ultimately. Of this we take advantage in the planting of nurses among hardwood trees planted after firs and pines. In many soils, however, where Scots pines have been cut down as a matured crop, the soil is what foresters generally term *foul;* that is, it is infested by insects, which prey upon the bark of young trees of the same species when planted as a second crop; and there are very few Scots pine plantations of any considerable extent in which these insects are not found. Even after the old trees have all been carried off, they will live and prey upon the bark about the roots of the trees that remain in the ground; and on this account it is often found a matter of great difficulty to get either young Scots pine trees or larch to come away after a crop of old ones,—the insects preying continually upon the bark, and consequently killing the young trees. This insect is termed the *Hylobius abietis.* It has the appearance of a small beetle, of a bright grey colour, and beautifully spotted, and from half to three quarters of an inch long. In its attacks upon the young Scots pine trees, it generally commences at the part next to the ground, and eats the bark all round. It proceeds gradually upwards, leaving the young trees peeled in to the wood, and the tree, of course, dies in a very short time. When there are larch planted among the Scots pines, it attacks them in the same manner, gene-

rally commencing its ravages pretty early in the season, when the young trees are in sap and beginning to grow.

889. Many plans have been tried by foresters to avoid the ravages of this destructive creature, one of which was to raise a little mound of earth round the stem of each young tree as it was planted, and to smooth it all round, so as to prevent the insects getting up its sides to attack the tree. This mode I have tried; and where the insects were not plentiful, it seemed to have the effect of preventing them getting up; but from more extended experience in regard to the habits of the insect within the last eight years, I am now led to state that the plan referred to, and recommended in the last edition of this work, is not adequate where the insects are plentiful, especially where the soil is light and sandy; as from this quality the polish made on the surface of the mounds is easily removed by the action of the weather, so that the insects are soon able to walk over it.

890. Since I came to take the management of the woods in Strathspey, I have found ample scope for experience in regard to this pest of the forester, and I am now, therefore, better prepared to give an opinion as to the mode of preventing its attacks. I find this insect very plentiful in all our old fir woods, so much so, that with a few women and boys, we have collected from 20,000 to 30,000 of them in two days. Before coming to Strathspey I had only been able to collect a few hundreds from any plantation which I had planted, and from this comparatively small number no great amount of damage could ensue. The second year after coming to Strathspey I planted about 100 acres of old woodland, from which a crop of pine had been cleared the previous year. The trees planted were oak, larch, and pine, and this was done in the autumn. In the month of April after, I looked carefully through the crop to see how they had stood the winter, and found that a large proportion of them had been attacked by the beetle. I therefore immediately got a few women and boys, each with a common bottle with a little water in it, into which I caused the people to put the insects as they collected them. I instructed them to examine the grass at the bottom of each plant, and especially that at the bottoms of such as they saw had been attacked, which was easily observable by the bark being eaten in patches, and in spiral lines, all round the trees. This was done early in the morning, and before the sun had risen high; as after the sun is high, and the heat from it strong, the beetles retire into the grass, and are not easily found till it is down again. In this way large quantities were collected, and as we had fortunately commenced early in the season, most of the old ones had been secured, as we found very few of them in that

plantation afterwards; and now the crop is as good as I could wish, only a few having been killed by the beetles. As, however, I found this mode of operation expensive, and as there was another enclosure to replant, which had been formerly under a crop of pine, I considered as to the best and cheapest mode of preventing their ravages. I did not wish to postpone the planting of the enclosure, as it was desirable to have a new crop on it as early as possible. I had observed, in my experience of the beetle in the case of the plantation just referred to, that they seldom or never attack the young trees after they have stood one year, and that wherever the earth is made flat and smooth for some distance round the stems of the plants, they do not readily attack them. With this experience, I determined to plant the enclosure in the usual way, and to cause the men, while planting, to avoid leaving any herbage within a circle of twelve inches diameter round the stem of each tree, taking the plant as the centre, and to make the earth perfectly smooth within the bounds of this circle by beating it with the spade. This I had done in the month of March; and in the month of April after, when the crop was examined, and when I expected to find the beetles in motion on it, very few indeed were discovered—in short, too few to do any important damage to the young trees. On one of the corners of this enclosure I planted the plants on a few acres in the usual way, and without having the ground smoothed about them. On this portion I found the plants very much injured—so much so that it required to be replanted; so that I now act upon this principle, that if no herbage is left near the plants, and if the earth is made perfectly flat and very smooth all round the stems, and kept so for some time after the plants have been put in, there is little danger to be apprehended from the attacks of these insects.

891. The following points in regard to the beetle, and which are in accordance with my own experience in reference to it since I came to Strathspey, may be found useful in dealing with the replanting of old pine woods in other parts of the country. I find that the insect only lives in a district while the inner bark of the trees on which it preys is fresh, or partly so, and that they cannot exist more than from four to five years after the trees have been cleared from the ground; as after that time the bark of the roots left in the ground is too much rotted for them to live on it. In Strathspey this fact is now acted upon, and we leave our old woodlands, after they have been cleared of their crop, unplanted for a period of five years, at the expiry of which period we can plant without any annoyance from its ravages.

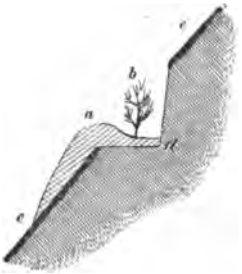
The thorough drainage of a piece of old woodland hastens the decay of the old stocks and roots of trees left on it, and therefore causes the insects the more quickly to die out of it, from the want of their food, which seems to consist solely of the inner bark of the pine and fir trees.

When we wish to hasten the decay of old stocks and roots of pine trees, in order the sooner to get rid of the beetle from the land on which they exist, all woody rubbish is burnt up, and the bark stript from the stocks, and burnt also. We did this on one district from which a crop of old pines had been cleared, and in three years afterwards the beetle had almost entirely disappeared.

892. In planting trees in pits, the planters should always be very careful to see that the best portion of the soil is put next the roots of the plants; for if this be not attended to the success will not be equal to expectation. They should also bear particularly in mind, to chop down and pulverise with the spade all soil which is put next the roots; for if put in about them in lumps, vacuities will be left, which will probably cause water to lodge there; whereas, when the soil is made firm and small, it gets in about the tender roots, nursing them kindly, and preventing superfluous moisture from lodging near them.

893. Where pitting is performed upon a sloping piece of ground, such as the side of a hill, the earth, as it is taken out of the pit, should be put to the under side, and close upon the edge; and when the trees are planted in these pits, the good soil upon the upper edge of the pit should be broken well down with the spade, and put in about the roots of the young trees, leaving all the soil which was taken out of the pit still lying upon the under side, in order the better to protect the roots from drought and retain moisture about them; forming, when the tree is planted, a bowl in which a little moisture can be retained in its descent down the hill. Fig. 124 will explain the nature of this sort of pitting: *a* represents the earth taken out of the pit; *b* the tree standing in the pit, which has been filled up with earth by reducing the bank behind as at *d*, the original slope of the ground being indicated by the line from *c* to *e*.

FIG. 124.

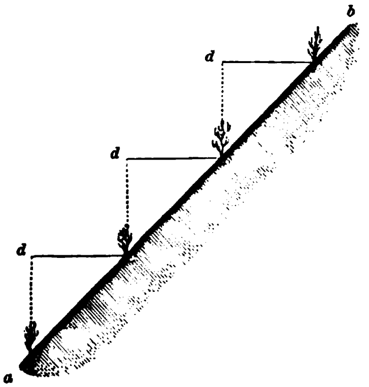


894. Although the spruce fir does not naturally grow in this country, when planted in a high exposed situation it will do well, and even grow to useful size in a plantation upon an exposed part, if it be but sheltered by other trees of a more hardy constitution, such as the Scots pine and larch. Every planter, therefore, who wishes to produce a variety of trees in any high part of the country, if he will plant spruce firs in the interior where they will ultimately be well sheltered, may depend upon raising spruce fir

timber of good and useful size; that is to say, if the soil be not too light and of a dry gravelly nature.

895. In planting trees in glens and steep hollow parts, the operator should not measure his distance between the trees with the slope of the ground, but in the manner as represented in Fig. 125, which is drawn to the scale of an eighth of an inch to a foot. The line *a b* represents a sloping bank, to be planted with forest trees at four feet apart; the places of which are shown in the figure at *c, c, c, c*. By measuring upon the line *a b* with an eighth of an inch scale, it will be at once seen that the distance between each tree from *c* to *c* is six feet; and had the planter planted his trees, measuring his distance of four feet along the slope, he would, when the trees grew up, have had them growing at about two and a half feet instead of four. In taking distances for planting trees in a case of this nature, the operator must always keep his *measure-stick*, if he use one, in the position pointed out in the figure by the line from *c* to *d;* or, in other words, he must, when taking a measurement for planting another tree, set the one end of his measure-stick at the bottom of the last tree planted, and, keeping it level, let fall a perpendicular from the other end for the place where the next tree is to be planted, as shown by the dotted line from *d* to *c*.

FIG. 125.



SECTION X.—KINDS OF FOREST TREES WHICH MAY BE MOST PROFITABLY PLANTED IN ANY GIVEN DISTRICT OF THE COUNTRY.

896. In raising timber as a profitable crop upon any landed property, two things require to be kept in view—namely, 1st, to plant those sorts of trees which will come to be of the greatest value in the nearest market; and, 2d, to plant those sorts which are most likely to grow to useful size upon the soil to be planted. In illustration of this, we may suppose a proprietor desirous of planting hardwood, such as oak, ash, elm, and sycamore. If his ground was not naturally adapted for the healthy growth of these sorts, he would ultimately be a loser by planting them, even admitting that he could get a ready market for the timber in the neighbourhood. On the other hand, were the same proprietor to plant pines upon his land

instead of hardwood, even although he could not get a ready market for such wood in his neighbourhood, he would (the land being adapted for pines) ultimately, from the healthy state of his trees, and the greater bulk of timber produced, be a great gainer by such culture. From this it will at once appear evident that, in order to receive the greatest possible value from timber in any given district, it is of greater importance to grow that sort of tree for which the soil and situation are adapted, than to grow that sort for which the greatest price may be given in the market.

897. On an estate thirty miles from a good market for oak timber, and in a district difficult of access, if the proprietor were to plant oak in a soil perfectly adapted to it, and at the same time to plant pines in another situation as well adapted for them, supposing that both grew equally well and arrived at good size, and that he had the same number of feet of wood in each per acre, yet, on account of the great distance there would be to carry the oak to market, there being no demand for it in the neighbourhood, the oak very likely, after deducting all necessary expenses, would not bring so much clear cash to the proprietor as the fir would do, there being, as we shall suppose, a great demand for it in the immediate neighbourhood. This I have frequently had occasion to observe, and I am aware that proprietors are often misled in this matter, calculating much upon any wood, such as the oak, which is famed for its value, but not calculating the expense necessary to be incurred in rearing that wood and getting it brought to market. Before proceeding to point out the different kinds of wood which may most profitably be planted in any certain district, I shall give a statement showing how the value of timber is affected by distance from market. The following are the prices at which I have seen wood sold on the ground in 1859:—

Oak, .	at 5	miles	from Leith,	at	2s.	6d.	per foot.
„ .	at 10	„	„	at	2s.	3d.	„
„ .	at 20	„	„	at	1s.	8d.	„
Larch, .	at 5	„	„	at	1s.	6d.	„
„ .	at 10	„	„	at	1s.	3d.	„
„ .	at 20	„	„	at	0s.	10d.	„
Ash, .	at 5	„	„	at	2s.	0d.	„
„ .	at 10	„	„	at	1s.	8d.	„
„ .	at 20	„	„	at	1s.	3d.	„
Scots pine,	at 5	„	„	at	1s.	3d.	„
„ .	at 10	„	„	at	0s.	10d.	„
„ .	at 20	„	„	at	0s.	6d.	„
Pit props,	at 5	„	„	at	3s.	6d.	per 100 lineal feet.
„ .	at 10	„	„	at	3s.	2d.	„
„ .	at 20	„	„	at	2s.	6d.	„
Firewood,	at 5	„	„	at	10s.	0d.	per ton.
„ .	at 10	„	„	at	5s.	0d.	„
„ .	at 20	„	„	at	2s.	0d.	„

From this statement, it is to be inferred that any proprietor, twenty miles from the market, must not expect to realise much more than half the value for his wood that his neighbour who is situated five miles from the market does, unless, indeed, he is favourably situated with regard to a railway; and so on in proportion to distance.

898. In all districts near to any ship-building port, or to the sides of navigable rivers and railways, to which access is easy, no wood can pay better than oak and larch, both of which are used in the construction of first-class vessels, and, indeed, in vessels of every size. I have seen oak timber, brought from a distance, draw a higher price per foot than oak grown near the market, in consequence of superiority in the quality of the wood; and I have heard a proprietor, whose plantations were within four miles of a thriving seaport, say that his plantations of pine paid him much better than his oak ones, his land not being so well adapted for the raising of oak as for pine. I mention these facts to avoid misleading any, because the value of wood as a crop upon any piece of land—let the locality in which it is grown be what it may—does not so much depend upon the kind of wood planted, as on whether the soil and situation are adapted to the kinds of timber planted upon it. Hence I always advise the proprietor of land to plant those trees which his soil and situation are best fitted to bring to perfection. In this case, although he may not have wood to answer the demand in the neighbourhood, yet when he takes into consideration the greater health of his plantations, and the consequent greater bulk of timber, he will find himself far better paid than if he had adopted a contrary plan. In the neighbourhood of all large towns there is a continual demand for Scots pine, larch, and spruce fir, for deals; and wherever the soil is adapted for the growth of these kinds of trees, they in general pay as well if not better, than any other sort of wood, seeing their growth is quick. Ash is a wood much in demand about all considerable towns for handle-wood and coach-building, &c., and pays any proprietor well, when his land is adapted to the healthy growth of it; such as in dells, and other local hollows having a good strong loamy soil. The Scots elm is also much used in large towns, frequently for the same purpose as the ash; but unless it be grown in a heavy loamy soil, or in a light loamy one, with a supply of water from a running stream, it will not prosper well, nor turn out a profitable tree to the planter.

899. In the neighbourhood of all large towns, a great quantity of wood is generally consumed in the form of fuel; and for this purpose many sorts of wood are used. In Scotland, where coals are plentiful, wood is never grown for the purpose of being consumed as firewood, only the tops and larger branches of full-grown trees being sold for this purpose, along with

the heavier timber when cut down; therefore, in Scotland, the raising of trees for firewood does not constitute any part of forestry; but in England, and particularly in the central counties, where fuel of every description is scarce, the raising of wood as a substitute for other fuel is necessarily resorted to, and constitutes a part of forestry. In order to meet the demand for firewood in such districts, hedgerow trees are kept down in the form of *pollards;* that is, the trees are headed down to ten or twenty feet in height, according to the kinds cultivated, and are allowed to produce lateral shoots, which are cut down again, at stated intervals, in the same manner as coppice-wood. These lateral shoots, from being so frequently cut over, become very numerous all over the trees, giving them the appearance of enormous coppice stools, and from them a great supply of young shoots is taken for firewood. Besides this supply, there are large tracts of mixed coppice grown in the usual way for firewood; that is, this sort of coppice is planted in the usual form of a plantation, and enclosed with a proper fence. The trees which are intended to form the future coppice are generally planted at four feet apart, using none but such kinds of hardwood as are known to produce a great quantity of stools from the bottom or collar when cut over; such as the oak, ash, sycamore, hazel, willow, poplar, &c. These trees, when first planted, are treated in the same manner as in the raising of hardwood for a timber plantation; but instead of thinning any out when they come to such a size as to stand close together—and that will be when the plants are from fifteen to twenty feet high, and from three to five inches diameter in the stem—they are cut over to the surface, and allowed to push up another supply of shoots for another crop. In this manner these stools may be cut over for a supply of firewood for an indefinite number of years, and at intervals, as may be found necessary in order to supply the demand. In cutting down these coppice plantations, the whole is not used for firewood, all the straight rods being used and sold for bobbin-wood for manufacturers, hoops, basket-willows, poles for various purposes, besom-spray, implement handles, &c.; and when the best of the wood has been picked out for these purposes, all the spray, and what may properly be termed refuse, is bundled up and sold in the form of fagots. Now, in districts where this sort of wood-produce is much in demand, it is certainly right and proper for the proprietors of land to grow it in order to supply the inhabitants with fuel; and in many instances large returns of profit have been made from such a mode of cultivating wood; but I do not see that it can be profitable for proprietors generally to plant their lands for the exclusive purpose of raising firewood. In poor tracts, where it would not be possible to raise large timber, this sort of crop answers well, and indeed pays well, as also in low swampy grounds. But wherever land is of a fair quality, the more profitable system is to plant, at a given distance, hardwood trees, to be raised as timber of full size, and allow the thinnings to be used for firewood as they are cut out. By this mode of going to work, a greater weight of wood will be taken from an acre of land at the end of a specified time, than if kept entirely under coppice, and consequently a greater return of profit would be received. In the districts in England where hops are grown, nothing pays better than the cultivation of small larches. These may be planted very closely together—say at from eighteen to twenty-four inches apart—and drawn up quickly for hop poles; and as the same land will produce several crops of the same sort, when planted in succession, very profitable returns are made, and at very little expense; while, at the same time, in raising such a crop, little or no professional skill is necessary in the person who grows it.

900. In districts where coal mines abound, great quantities of wood of various kinds are in demand; as in the Lothians of Scotland, and the neighbourhood of Newcastle in the north of England. There the demand for wood of all sorts to supply their various purposes is very great,—more particularly for *propwood*, which is generally small thinnings of various kinds of wood not less than two and a half inches diameter at the small end. In the neighbourhood of coal mines, the most profitable wood to plant is, first, larch, which, in a young state, when taken out as thinnings —say from three to five inches in diameter—is in great demand as propwood. When of a larger size—say about eight inches diameter—it is much sought after for small sleepers to lay under the rails upon underground railwheu; and when of full-grown size, the larch is used extensively as common railway sleepers, and as boards for various purposes. Second, Scots pine, when of small size, is also used for propwood, and, when of full age, for sleepers and boards. Third, Poplar and willow are much sought after about coalworks, particularly when of good large scantling, and are used in the form of plank for clothing the waggons. Fourth, Ash is also much used about coalworks for handles to picks. Fifth, Elm is also a good deal used for trams to the underground waggons. Sixth, Oak is also in considerable demand about coalworks, and is used for framing for the large waggons, and for various other purposes connected with such establishments. The above are the principal sorts of wood used for coalworks; but the most important in such districts is small thinnings of wood of every kind, provided it be of a size averaging from two and a half to five inches in diameter, which is now generally sold at from three to five shillings per hundred lineal feet.

901. In the neighbourhood of flax manufactories, there is always a great

demand for plane-tree bobbins about six inches in diameter, as also of a smaller size, which are generally made of birch. In the neighbourhood of all considerable manufacturing towns, and more especially where there are bleaching-works, there is an extensive demand for plane-tree of a large scantling, where it sells sometimes at a very high price. For railway purposes a great deal of wood is now used in the form of sleepers, for which larch and pine are used; in the form of posts and rails for the purpose of fencing the fields along the line, for which larch and pine are also mostly used; and in the form of waggons of various kinds, for which purpose ash, elm, oak, and fir are used. In the making of a line of railway, the contractors require a great quantity of wood from the different proprietors through whose grounds they pass in the act of working, and in cases of this nature a good price is generally given for the wood; but the sales of this description are only of a temporary nature, in so far as the contractor's work is to be calculated upon. When, however, a line of railway is opened up through any gentleman's property, although he should be twenty miles off, he is, in respect of a market for his wood, or indeed of any other produce upon his estate, nearly on a level with his neighbours who may be within five miles of the same market. In such circumstances, the proprietor may plant any crop that will best succeed upon his land, and calculate upon having it brought to market in a cheap, sure, and expeditious manner. In such a case, if the proprietor find his land adapted for the growing of the more valuable kinds of timber trees, he need not be in any hesitation as to planting and rearing them, although he may not have a market near for their sale; because, when his wood is ready for cutting down, he can avoid the expensive process of horse-cartage, and put his trees at once upon trucks adapted for the purpose; and at a very trifling expense he may have them conveyed fifty miles to market, and sold and delivered much quicker than his neighbour who may have to cart his wood only five miles to the same place, although the trees may have been all cut at the same time. This I have seen frequently done.

902. In conclusion upon this head, I have to state that every proprietor of land who intends to plant a portion of it with forest trees, should not reason with himself merely as to what kinds of trees will sell best in his neighbourhood when grown. He should, on the contrary, also study the nature of his soil and situation, and plant those sorts of trees upon it which will thrive best and arrive at the greatest state of perfection, let the kinds be what they will. If he do this, he will have the greatest possible bulk of timber from a given number of acres in a given number of years; and will realise the greatest sum of money as their value. But if he act in an

opposite way, and plant trees not adapted to his soil and situation, he will without doubt spend his money in the first place uselessly, and the after result will be vexation and disappointment.

SECTION XI.—KINDS OF TREES BEST FITTED FOR HEDGEROW TIMBER, AND MANAGEMENT OF THE SAME.

903. At the present time, when agriculture is improving so rapidly, many of its advocates are crying out vehemently against hedgerow timber, declaring to an enlightened public that all hedgerow timber trees are injurious to the raising of plentiful and healthy crops in the fields upon the edges of which they are planted. That this is true to a certain extent cannot be denied; but hedgerow trees being in some cases injurious to the crops in the adjoining fields, cannot so much be attributed to the presence of the trees themselves, as to bad management in growing them; for let it be kept in view, that anything, however useful in itself when properly managed, if it be allowed to overstep due order and balance, at once becomes an evil instead of a good. This is the very state of a great many hedgerow trees, particularly in England, at the present day. In many cases the kinds of trees have not been adapted to the nature of the soil, thereby causing them to spread too much; and in most the trees have been entirely left to nature, never having been trained up with the view of doing good as shelter to the adjoining fields. They have thus often become a pest; have been allowed to spread out their branches widely upon all sides; have been irregularly and most injudiciously planted; have been topped and mutilated, and made to answer any purpose but that of doing good to the farmer: in short, hedgerow timber at the present day is a part of forestry the least understood, and yet its proper management is of the greatest importance both to the proprietor and the farmer. Hedgerow trees, when trained up and managed upon right principles, instead of being a nuisance to farmers, become of first-rate importance in all well-cultivated districts; and instead of impoverishing the land, they become a source of fertility to it.

But although this may properly be said to be the state of things generally relative to hedgerow trees, there are nevertheless many fine examples of their being well managed; and in such cases I have heard farmers say that they were very much benefited by the shelter produced by them, and would not upon any account have parted with them. Having seen both the evil arising from badly managed hedgerow trees, and the good which is derived from them to all parties when grown in such a manner as to answer the desired end, I am prepared to speak from experience upon the matter, and to give my advice as a practical forester, as to the best method of growing hedgerow trees, so as to produce the greatest amount of shelter, and, at the same time, to cause as little shade upon the land as possible.

904. The planting of hedgerow trees is generally done with a threefold view—namely, that of raising useful timber in the country, without occupying much breadth of land exclusively for that purpose; the producing a degree of shelter for stock and crops in the adjoining fields; and the giving the country a clothed and ornamented appearance.

905. Now, all these three objects can be most amply attained without any injury whatever being done to the agricultural produce of the country. Before, however, proceeding to detail how this can be done, it will be necessary first to make a few observations as to how far these objects have been attained by the past or present system of managing hedgerow trees, and at the same time to point out the injurious effects of the system by which the existing class of these have been chiefly reared. Generally speaking, hedgerow trees, as they have been managed, and as we now find them, are not of great value to the proprietors, or of much advantage to the country. The reason is, that no attention has been paid to their culture. In some districts, both in England and Scotland, where, of late, attention has been paid to the pruning of hedgerow trees, much good has arisen from their influence. In all cases, trees planted in hedgerows are freely exposed to the air; consequently, the natural habit of trees under such circumstances is to become branchy; but if the forester apply his knowledge and practical skill to trees under these circumstances, he can, by the timely use of his knife, check this rambling habit, and give them a contrary tendency; and it is in a great measure from the want of this application of timely pruning, that hedgerow trees are now of so little value as timber, and so ruinous to the fields. That shelter has been produced to the fields from the existence of trees about them is evident; but then the amount of good which has been done in this respect has been overbalanced by the shade they have cast upon both sides from the spread of their branches, causing a deficiency in the actual crop upon the shaded parts. Thus it cannot be said that much real good has arisen from the presence of hedgerow trees.

906. That they are an ornament to the country, and give it a clothed appearance, is admitted by most travellers passing through it. But the farmer, who has his rent to raise off the land, when he looks upon the trees in his hedgerows, and is aware of their doing him much damage, feels no pleasure in them, but becomes desirous to have them removed, in order

that he may have the land occupied by them brought into more profitable use.

907. Farmers are, generally speaking, averse to the growing of hedgerow trees upon their land, and declare that they are ruinous to their crops, both from the great shade they produce, and from their harbouring vermin in their vicinity. I have frequently tried to convince them of the bad consequences that would follow the entire extermination of hedgerow trees from any particular district, pointing out to them the beneficial effects of shelter when that can be secured without doing injury to the land. In this respect I have found the most intelligent of them to agree with me, they being most anxious to have their land sheltered, provided that can be done without occupying much ground, and without causing much shade upon the crops. This is the very thing required; and in order to attain it, these three rules should in all cases be strictly adhered to: 1st, To plant all hedgerow trees upon the surface of the land, and in straight lines; 2d, To plant no trees but those of an upright habit; and, 3d, To keep the trees regularly pruned and within given bounds. I shall now give a few hints, showing how all this can be done.

908. 1st, In travelling through England, one is particularly struck with the manner in which hedgerow trees have been planted, that being for the greater part upon raised banks of earth, with sometimes a deep ditch on each side, sometimes with a ditch upon the one side and a dyke upon the other. Frequently too, we find this bank of earth overgrown with thorns, brambles, and other rubbish; making altogether, with the broad-spreading trees, a formidable mass of very considerable extent. This is the state of things that farmers complain of. Now, in order to grow hedgerow trees upon right principles, the trees in this state should be taken out, tiles put into the ditches on each side in order to convert them into proper drains, the bank levelled down over them, the ground trenched, and a requisite quantity of lime put into it in order to decompose all the old roots the more quickly. This being done in the spring months, the ground so dealt with should be subjected to a summer fallow; in the autumn, a hedge of thorns or beech should be planted in one continuous straight line upon the surface, putting in a young tree among the hedge plants at every thirty feet for hedgerow timber, keeping in view that each alternate one shall be thinned out as they advance in size. In the act of renewing the fences in this manner, any alteration could be made that might be considered an improvement upon the old style, such as, in some cases, omitting the renewing of some of the fences altogether, and consequently enlarging the fields so far as might be considered necessary. In some cases a new fence might be made along the middle of a field, thereby making such a new

fence upon new land, and converting one field and a half of the old into one of the new ; and in the act of making such improvements, the direction of the line of many of the present fences could be altered so as to suit the views of the improver.

909. 2d, A great error has occurred in the rearing of hedgerow timber, in planting those sorts of trees which are of a spreading habit, and not easily kept within due bounds. The following trees are the only ones which should be planted in the neighbourhood of fields :—The oak, the English elm, the sycamore, the Norway maple, the birch, the sweet chestnut, the poplar, the willow. These are all trees more or less of an upright habit, and such as, by the timely use of the pruning-knife, can be easily kept within due bounds. We often find the ash growing as a hedgerow tree, but it ought very sparingly to be planted under such circumstances. When standing alone and exposed to free air, its top is extremely liable to diverge off into large limbs ; and, what is even worse, the roots of the ash are of all other trees the most searching upon land, and impoverish it very much.

The beech is another tree we frequently find growing in hedgerows; but I object to its being used under such circumstances, for these reasons: —I have always observed, that under the drip of beech trees a thorn hedge will not prosper ; and, as far as my experience goes regarding agriculture, grass and grain do not thrive under it either. Besides, the tree is of a diverging habit when standing alone, and does not do with much pruning when of large size. Another peculiarity of the beech is, that, when growing in a free open situation, it is always found leaning to the sheltered side; that is to say, if the prevailing winds of the district be from the west, the tree will be extremely bare of branches upon that side, and over-heavy upon the opposite side, giving it an oblique attitude, which, of course, does not answer in every situation, and more particularly when growing as a hedgerow tree.

910. The fir and pine tribes are all trees of an upright habit ; but they are not adapted for standing alone : they always thrive best when congregated together. Besides, the roots of these trees run too shallow for growing upon the borders of fields where the plough must have free access to their very boles. No fir or pine tree, therefore, should be planted as a hedgerow tree.

911. 3d, The training up of the young trees planted in hedgerows is a matter of the greatest importance, and should be most perseveringly attended to. We shall suppose that trees of the kinds above recommended for hedgerows have been raised in the nursery for the purpose ; and for this purpose every proprietor should raise his own trees. These should be

pruned one year before they are lifted from the nursery ground, so that they may not be injured in any way when transplanted; and the size of the tree should be from five to seven feet. If trees for hedgerows are planted of sizes much above these, they do not succeed so well, as they are more apt to grow branchy than tall, which state of things is of course to be avoided where trees of proper character are an object. Many, indeed, plant their hedgerow trees of sizes much above what we have stated; but in such cases we have always found them grow of a spreading habit afterwards. They should be lifted from the nursery with great care, not taking away any of the earth from their fibrous roots, but letting it remain about them in the form of a little ball to each; and by attending to this, the success will be the more certain, and prove more satisfactory afterwards.

912. The hedgerow being planted with thorns to form the fence, and spaces being left in them at intervals of thirty feet for the trees, have them planted, each kind to answer the nature of the soil as nearly as possible; and upon both hedge and trees being planted, put a fence of paling upon each side, if there are to be cattle in the fields, attending to the cutting of the hedge, as has been advised in its own place. These hedges, when at their full size, should never be more than three feet in diameter at bottom. As the trees advance, let them be regularly pruned, causing each of them to have ultimately a clean stem of from fifteen to twenty feet high, in order to allow the hedge under them to have free air; and as the tops of the trees advance in breadth, their branches should be shortened well in, so that, when they have arrived at thirty years old, their side branches may not extend more than four feet over the fence upon each side. In order to keep them in this state, they should have their branches shortened in every two or three years; and even when they have attained full size, they should not extend more than seven or eight feet over the hedge upon each side. In these things being properly attended to, the whole art of growing hedgerow trees consists. In districts where fuel is a scarce commodity, the prunings, as they are taken from the trees, should be gathered up and used for that purpose. To those who may never have seen trees kept in the way that I recommend above, it may appear at first sight that a line of hedgerow trees kept in this manner will have a stiff and formal appearance. In this they are quite mistaken; for having myself seen trees kept thus, I maintain that they by no means present a formal of stiff outline, but, on the contrary, have a very ornamental effect, and form, when well kept, an agreeable object.

No doubt, were the trees to be clipped with the shears, they would certainly have a very formal appearance; but as they must in all cases be pruned with the pruning chisel, their forms can be varied very much, and that with very little trouble, when the work is progressively well done, and no neglect takes place.

913. The advantages of this system over the old one are many, and of vast importance to both landlord and tenant.

By the old, or I may rather say the present system, of growing hedge fences and hedgerow trees in England and in many parts of Scotland, there is generally from eight to fifteen feet in breadth of land wasted, and taken up for that purpose, upon the boundary of every field where they exist; whereas by the method I recommend, and which is being practised in some districts of Scotland, only three feet in breadth, at most, is occupied by the fence or hedge; and as the trees are not allowed to grow beyond a certain breadth, their shade does not materially injure the crop even when sown close into the side of the hedge; while, at the same time, from the shelter afforded, the crop is very much improved; and, moreover, the hedges never being allowed to grow above four and a half feet high, and the trees being kept clear of branches on their stems for at least fifteen feet up, a free current of air is allowed to pass everywhere, keeping both the hedge and crop upon the land in a healthy state.

The trees, when treated in the manner above recommended, in consequence of being so much kept in upon the side branches, soon become tall, and form fine trunks of timber. In order to gain this end quickly, the top of each tree should have the lead from the very first, and no side branch be allowed to gain strength upon it.

SECTION XII.—EXPENSES OF LAYING DOWN LAND UNDER PLANTATIONS.

914. In calculating the expenses likely to be incurred in the laying down of a piece of land under a crop of young forest trees, the proprietor has to consider, first, the nature of the figure in which he may intend to lay out his plantation. On the form or figure of a plantation much of the expense of fencing it depends; and as this item forms a very considerable proportion of the entire cost, it will be proper here to show the circumstances which, when attended to, lessen this expense.

915. When a proprietor intends to plant a piece of land upon his estate, say to the extent of fifty acres, he cannot exactly calculate the sum that would be required for the fencing of it until he has laid out, and actually measured, the line of plantation; unless, indeed, he shall fix upon a regular-sized figure. In order to illustrate the truth of this, I shall here give an example:—To lay out a plantation of fifty acres in extent in the form of strips, of four chains or eighty-eight yards broad, the proprietor would

require to erect 5676 lineal yards of fence to enclose it; and supposing the fence used in the enclosing of this plantation in the form of strips to be stone dyke, costing 1s. 6d. per yard, then the whole expenses of fencing, in this instance, would amount to £425, 14s.,—equal to £8, 10s. 3d. per imperial acre upon the land enclosed.

916. Again, supposing that, instead of laying out the fifty acres in the form of strips, the proprietor wished to lay out the same quantity of land in the form of a regular square, then the side of a square that would contain fifty acres will be 490 yards; consequently the four sides added together will amount to 1960 lineal yards, which would be the extent of fencing required, instead of 5676 in the last instance, although the same quantity of ground is enclosed in both cases. Supposing, as before, the 1960 yards to be stone dyke, at 1s. 6d. per yard, the whole expense of fencing the square fifty acres would be only £147,—equal to £2, 17s. 9d. upon each acre of the land enclosed. Now, this at once points out to proprietors of land the great utility of planting all plantations in a solid compact form, in order to prevent a large original outlay. By the cheaper method, a much more valuable plantation is raised, apart from any other consideration.

The above examples point out the impossibility of giving anything like a just rule whereby the expenses of fencing ground for a new plantation can be ascertained, as these in all cases must be influenced by the form in which the ground is laid out. I shall, however, give two examples, as under:—

917. For small plantations on home ground with hardwood, enclosed by stone wall five feet high, with mortared cope:—

To medium expenses of fencing, per acre, with stone wall, 76 yards at 1s. 6d.,	£5	14	0
To 100 yards of open drains, at 1½d. per yard,	0	12	6
To 435 pits for hardwood, at 1s. 6d. per 100,	0	6	6
To 435 hardwood trees, at 20s. per 1000,	0	8	8
To 1500 larch, at 12s. per 1000,	0	18	0
To four days of a man planting an acre, at 2s. 6d.,	0	10	0
	£8	9	8

918. For an enclosure of 500 acres of moor ground with pines only, enclosed by turf dyke, and paling on top:—

To medium expenses of fencing per acre with turf dyke and paling, 20 yards at 6d.,	£0	10	0
To 100 yards of drains, at 1½d. per yard,	0	12	6
To 3000 pines, at 5s. per 1000,	0	15	0
To three days' planting, at 2s. 6d.,	0	7	6
	£2	5	0

The first example contains the highest cost per acre that I ever found necessary for making of hardwood plantations,—and the second contains the lowest that I ever could get the work done properly for.

919. When plantations are made of small extent, the expense of fencing, as I have already stated, comes to a very high figure on the acre, as is shown in the case of the first example; while the larger they are made the less it is per acre, as shown in the second example, in which the entire cost on the acre for fencing is only 10s. I may state further, that in planting in Strathspey, as our enclosures are large, the expense of fencing is indeed very small per acre, as not long since we made an enclosure of some four thousand acres, the expense of fencing which did not cost over 4s. per acre. On this branch of the work, therefore, as is to be seen from these examples, much of the expense of planting depends, this being regulated by the size of the enclosure.

SECTION XIII.—THE KEEPING OF TREES IN A YOUNG PLANTATION CLEAR FROM GRASS AND WEEDS.

920. Any piece of land having been planted with young forest trees, in order to preserve them in a healthy growing state, it is necessary to have them kept clear of all long grass, as well as any other weeds that might have a tendency to injure them, by over-topping and crushing them down. The forester, then, should keep a sharp look out during the summer season, particularly the first one after the young trees have been planted; and wherever it is observed that the grass or any other weeds are likely to become strong, and to keep down the young trees, a careful man, with a few women and boys under his superintendence, should be sent over the different young plantations, who, with common shearing sickles, should be made to switch away all grass, &c., from every young tree that may require this to be done.

921. This work must be carefully done, particularly where boys or other young people are employed, as they are very apt to cut off the tops of many of the young trees if they are not strictly looked after; therefore the man who is put over them should not work alongside with them, but go immediately behind them, and closely inspect all that they have done as the work proceeds, observing that they do not pass over any young trees requiring to be cleared, as well as seeing that those cleared be done in a proper manner. This operation ought to be performed twice during the summer season—viz., between the middle and end of the month of June, and a second time in the month of August; and where the trees are grow-

ing among vegetation of a rank description, the same process may require to be repeated for three or four years successively, or at least until the young trees have risen above the rank growth of the weeds in the summer season.

922. Young trees, besides being apt to be injured by grass and other common weeds, are often still more seriously hurt by whins and broom growing among them. It very often happens that young trees are planted where whins and broom have been cut down and not grubbed out by the roots, in which case the whins in particular are sure to push out a stronger and more vigorous growth than ever the following year. Whenever this may have been the case, the planter ought to have particular attention paid to such parts, and see that the young growths of the whins, as they rise up, do not hurt the young trees. For clearing away these shoots, a strong sickle will be found to answer the purpose well; and in the doing of the work, they ought to be shorn clean by the surface of the ground whereever they are found among the young trees, whether they may be injuring them in the mean time or not; for though the whins may not hurt the young trees in many places in a young plantation for the first year of their growth, they will decidedly do so the second year, when it will be much more difficult to get the better of them. Therefore it is always necessary to cut such rubbish during the first year of their growth, when in a soft state; besides, if they are allowed to stand undisturbed upon the ground for a whole year, they give shelter to rabbits, hares, and other vermin, which are always a most dangerous stock in young plantations.

923. Where whins have been, even although they may have been grubbed up, it is, I am aware, a most difficult matter to take them out so clean as to prevent any roots that may be left in the ground sending up shoots of considerable strength the first summer after; consequently, it is necessary to attend in a particular manner to those young plantations where whins have existed previous to the young trees being planted. I have frequently seen large tracts of young plantations entirely ruined from not having been cleared from rubbish in due time; and in such a case, where this necessary clearing of the young trees has been neglected, a replanting of the ground must take place before anything good can be expected. This of course is the cause of a great outlay of money, all which might have been saved had due attention been paid at first.

924. The necessary expense of doing this sort of work is but trifling. I generally employ a man, with six young people, from the beginning of June to the end of August, constantly clearing among the young plantations; and I find that where no whins are, the expense of keeping clear a young plantation, for the first four years, taking the extent cleared, is about

sixteen shillings per acre; and where there are whins to contend with, the operation costs about twenty-five shillings per acre, until the trees rise above them.

In asserting the above, as to the expense of keeping young trees in a plantation clear of weeds, &c., I do not mean to say that the whole of the trees growing in a plantation will require to be so dealt with: that will depend entirely upon the nature of the original grasses, &c., growing on the surface. It is quite possible that not even one-fourth the extent of a plantation may require to have the young trees thus cleared; but wherever they are likely to suffer from weeds, &c., they should be attended to in the manner advised.

SECTION XIV.—GAME INJURIOUS TO YOUNG TREES.

925. It is a remarkable fact in the history of the rural economy of this country, that although partridges, pheasants, grouse, hares, rabbits, and deer, are well known to be injurious to the interests of both landlord and tenant, they should be allowed, in these times, to exist to the great loss of the community. The fact can only be accounted for on the principle that the landlords themselves are not yet sufficiently alive to their own interests in their land, nor to those the public have a right to expect at their hands as the proprietors of the country. We every day hear of the complaints of farmers in regard to their crops being to a great extent destroyed by the creatures we have named, and notwithstanding all their just complaints, how little redress they receive at the hands of their landlords! The public newspapers now and then take up the losses of the farmer; but I am not aware that the case of the forester in regard to the same evil bearing upon the young trees he rears, has been laid before the public. This may arise from the loss in this respect falling upon the proprietors themselves; but this is a narrow view of the case, as when a proprietor is obliged to spend £500 extra on the replanting of trees that have been destroyed by game, he must of course be to this extent the less able to benefit his property in other respects. I therefore here lift up my voice against the evil which constantly arises from the destruction of young trees in our plantations, by hares and rabbits especially. The loss to the country from these animals, in the department of forestry alone, must be very great, as on the greater number of extensive landed properties, large sums are annually expended in the replanting of enclosures which have had their crops less or more destroyed. I could give startling facts on the point; but as I have no wish to be personal in my remarks, but am merely desirous

to point at the evil in a general way, I shall not refer to any case in particular. Landed proprietors, generally speaking, look upon their enclosed plantations as so many game preserves, and in reality they are so, as on most estates game lie quiet, and therefore breed there; and on most not even the forester himself is allowed to prosecute the necessary operations of thinning, for fear of disturbing the animals. The farmers in the neighbourhood of such woodland enclosures complain of the damage done to their crops; some are allowed to kill such hares and rabbits as they find on their fields, but what good results from this? They dare not go into the enclosures to kill them, and from these the animals sally out upon the crops at all times, and when the attempt is made to kill them on the fields, they run back to their covers, and thus the poor farmer is surrounded by an host of enemies he dare not attack in their dens, and is ultimately obliged either to submit, or to give up his farm. Let us now consider the point more in an arboricultural point of view. The forester plants an enclosure of some fifty acres. He thinks, as he proceeds with his work, that although there is a considerable quantity of game in the older enclosures, he has seldom seen many on the part he is about to plant. He encloses it, however; and no sooner is this done, than from its quietness it becomes the resort of hares and rabbits, which it was not before, while it was pastured, and in the hands of a farmer. It is enclosed, however, and of course he must plant it. This he does, and not many months afterwards he finds the stems of his oak trees stripped of their bark, and the tops of his larch eaten off, and this goes on day after day, while the forester looks on helplessly; for although he complain, his voice is not much attended to, because the gamekeeper protests that there are few hares, if any, in the enclosure, knowing that his employer is desirous he should have a good stock to shoot at when a day's sport is wanted by his master's friends. But we have said enough on this subject, and shall conclude by stating, that if these pests were altogether destroyed from the country, planting operations would not cost nearly so much as they generally do, and their results would be vastly more satisfactory.

CHAPTER VI.

SECTION I.—THE NATURE AND PRACTICE OF PRUNING HARDWOODED TREES.

926. For several years past, many conflicting opinions relative to the pruning of forest trees have been issued in some of the periodicals of the day; which opinions, I believe, have had more a tendency to darken the point referred to, than to throw light on it. Many have recommended pruning as an operation eminently favourable to the health of forest trees; many more doubt this; and as many more affirm that pruning ought not to be practised at all: and each, as he advocates his own peculiar system of management, gives an instance of some plantation he has had under his care, as undeniably illustrating the advantages of the system he recommends. Now, all the diversity of opinion arises from the want of a properly extended knowledge of the science of vegetable physiology in the case of those who generally practice pruning, and from a proper application of it to the subject in question. A man of sound views and extensive experience comes to find that no particular rule can be laid down to answer the pruning of trees in all cases. He finds out that pruning in some cases is proper, and in others improper; but the untaught and inexperienced man, who wishes to be instructed in the art of pruning, when he sees one man strongly recommend it in all cases, and another as strongly urge its not being practised in any, is brought to a stand. He becomes bewildered, and knows not how to proceed; he is not able, from deficiency of knowledge and experience, to determine whether in his own case he should prune or not. Now, the only way reasonably to confirm the mind upon this important point is, not to lay any particular stress upon any particular example that may be given, but to examine the true nature of the art of pruning, and the tendency it has to improve or retard the healthy development of trees in various situations. In short, in order to a right understanding of the nature of pruning as applied to forest trees, attention must be paid to its effects upon trees under every variety of circumstances. I consider it proper that every proprietor of plantations should be able to

judge for himself in the matter of pruning, and to detect proper from improper pruning. And to this end I shall enter minutely into detail under this head, and give a distinct statement of my reasons for doing it in one case and not in another. But before doing this, it will, I think, be proper first to examine the effects that the amputation of a branch from a tree has upon its constitution: such previous knowledge will prepare the mind for a better understanding of the true nature of pruning as it is generally practised among intelligent foresters.

927. A tree, through the agency of its roots, draws nourishment from the earth into which these enter, chiefly in a state of solution in water; which liquid nourishment, or, as it is generally termed, the sap, ascends the trunk through the longitudinal vessels or pores; from which, again, each branch or limb of the tree is supplied in succession. The body or trunk of a tree forms one bundle of longitudinal tubes, through which the sap ascends from the roots to the branches. From this bundle each separate branch is supplied by its own separate line of tubes; or, which is the same thing, each particular root of a tree has to draw nourishment from the soil to supply its own particular branch; and the communication between these two points is maintained by a particular set of vessels in the trunk of the tree. The watery part of the sap, when it ascends into the leaves, is for the most part given off by them in the form of perspiration; that which remains at this point undergoes a change previous to its descent in the form of proper woody matter, which change is effected by the leaves inhaling *carbonic acid* and other gases, which enter into the composition of the returning sap; and in this manner there is a continual circulation of the sap in the tree—the roots drawing in and supplying the whole with moisture, which, when it is raised to the leaves, undergoes a chemical change, and is returned in the form of proper woody matter. The practical deduction to be drawn from this is, that every branch growing out of the main body of a tree is by nature meant to act as a laboratory, in which woody matter is prepared and returned for the joint supply of itself and the body of the tree. From this we are bound to conclude, that when we cut a branch from a tree we take away from it the means of supplying it with a certain proportion of woody matter for its enlargement; and this is, indeed, the case with pruning in all cases of the operation. But under good management in pruning, this depriving of a tree of its due means of nourishment is only temporary; and in one or two years after the operation has been done, and when the tree operated upon has had its growth properly directed, the increase of timber is at once remarkable, as compared with others of the like nature and age which had not been pruned, or with others which had been unscientifically managed.

928. When a large branch is cut off immediately from the body or trunk of a large tree, the usual sap which supplied it in its ascent from the roots, will be stopped short, and for a time will ooze out at the cut part. In a short time, however, the sap, as it rises in those vessels of the trunk which formerly supplied the branch taken off, becomes stagnated, and causes rot in that part, which can never be the case while the branch remains to draw up and prepare the sap in its leaves; and this is the case in all instances of large branches cut from large trees. But in the case of a branch being thus cut from a young sapling in a rapidly growing state, the tree is not injured, but improved; the sap of the plant being in such a vigorous state that rot cannot take place. Now, the practical deduction to be drawn from this is, that the amputation of a large branch immediately from the body of a large tree, instead of being favourable to its health and value as timber, has quite the contrary effect. I say, immediately from the body of the tree, because the cutting off of a part of a branch is by no means injurious to the health of a tree; but, on the contrary, when part of a large branch is cut off, the flow of sap to that part is checked, and the body or trunk of the tree is in proportion enlarged.

929. In Professor Lindley's *Theory and Practice of Horticulture*, there are some paragraphs so much to the point on this subject, that I think it right to bring them under the notice of the forester here. In the work referred to the Dr states: " The quantity of timber that a tree forms, the amount and quality of its secretions, the brilliancy of its colours, the size of its flowers, and, in short, its whole beauty, depend upon the action of its branches and leaves, and their healthiness. The object of the pruner is to diminish the number of leaves and branches; whence it may be at once understood how delicate are the operations he has to practise, and how thorough a knowledge he ought to possess of all the laws which regulate the action of the organs of vegetation. If well directed, pruning is one of the most useful, and, if ill-directed, it is among the most mischievous, operations that can take place upon a plant. The object of pruning is either to influence the production of flowers and fruit, or to augment the quantity of timber."

"Pruning is nothing less than the removal of leaves. To cut off a branch in summer is evidently so; and if the branch is naked, still its removal is the destruction of the part from which leaves would have been produced had it been permitted to remain."

" Prune not at, all should therefore be the maxim of the forester. Plant thickly, thin constantly, stop carefully, and leave the rest to nature. But unfortunately it does not happen that he who plants well always thins constantly; it is still more rare that stopping is thought of; and so a maxim, one of the soundest in the whole system of forestry, cannot be observed. Hence pruning may be regarded as a necessary evil, to which the wise must submit because of the ignorant; the careful to cure the evils inflicted by the careless."

930. During my practice as a forester, I have had extensive opportunity of observing the nature and quality of full-grown timber as it has been affected by different kinds of management in the way of pruning. Having seen much timber of all ages cut up for different purposes at saw-mills, I have had occasion invariably to observe a practical truth, that wherever branches of above four inches in diameter at their base had been cut from the trunk of the tree, the wood for a considerable way under that part which had been so pruned was worthless, and of a black colour. Where much cutting of large branches had taken place in one individual tree, I have always found such a tree to be scarcely fit for any valuable purpose whatever when it came to be cut up. Where the pruning had been done a considerable number of years before the tree was cut down for use, the wounds upon the surface were not easily observable; in fact, such trees often appear sound to outward appearance; but when the bark and outer covering of sap-wood is removed, the pruned part is at once observable, and the vessels leading from it, down to the roots, are generally found soft and of a black colour.

On the other hand, I have always had occasion to observe, that in the cutting up of trees which had not had their large branches cut off close by the trunk, the timber was of good quality, and sound throughout, excepting where extreme old age had caused natural decay; and of the truth of this I am perfectly convinced. Therefore, I urge every proprietor of plantations, never, as he values their health as timber, to cut clean from the boll of a tree a branch which is more than four inches in diameter at its base, and of this size, only if the tree from which it is removed is large, and in full health.

931. Having now pointed out the effects the amputation of a branch from the trunk of a tree has upon its constitution, I next proceed to detail the method which ought to be practised with pruning operations in all cases. And in order to a right understanding of this most important point in arboriculture, I shall bring under consideration the pruning of trees, from the time they are planted out from the nursery, to that of their full growth in the forest, under every variety of circumstances, as I have had occasion to observe them..

932. Many foresters are in the habit of closely pruning all young hardwood trees, particularly elms and oaks, when they are newly taken from the nursery grounds, and preparatory to planting them out in the forest;

which close pruning is most injurious to the health of all young trees when newly lifted from the ground. The system generally practised by foresters in this case is, to cut off clean to the main stem all strong branches, and only leave a few small twigs near the top of the plant, with the view of drawing up the sap. The natural consequences of such a cutting off of all the stronger branches from a young tree are, that, when the sap ascends in the plant in the spring, it is arrested at the wound where the first or lowest branch was taken off, and escapes from the cut part by evaporation. It being thus arrested, there is a natural effort made by the plant to produce young shoots and leaves at this point, in order to convert the sap into proper woody matter; consequently, we almost always find a few young shoots made the first season immediately under the part where the lower strong branch was taken from the plant, while all the rest of the young tree above this growth of young shoots dies—the sap not rising to carry on life above the part where the new shoots spring out. Even if the sap should not be all arrested at the point referred to, the part above it remains in a sickly and unhealthy state; while the young shoots produced lower down draw all the nourishment to themselves, and ultimately form a distorted unshapely plant, unless it be carefully attended to, by giving some one of the shoots the preference, and, cutting away all the rest, allowing it to become the top.

933. The proper manner of proceeding with the pruning of forest trees, as they are newly lifted from the nursery, and preparatory to planting them out, is to *shorten* all the *larger branches* that have the appearance of gaining strength upon the top or leading shoot of the young tree. This shortening of the larger branches ought to be done in such a manner as to leave only from one-half to one-third of their whole length remaining, with, if possible, a few small twigs upon it, in order the more readily to elaborate the sap as it rises in the spring; and in this state the young trees may be planted with the greatest assurance of success. The great advantage of this method of pruning young trees is, that when the sap rises in them, the first summer after planting, there being a regular supply of small proportionable branches along the main stem, leaves are formed, and sap is drawn up regularly to every part of the tree, consequently, the tree maintains an equal vigour throughout. Were all the branches left upon the young trees, the roots, from the effects of removal, would not be able to supply the whole with due nourishment; and the consequence would very likely be, that the plants would die down to the ground-level, from which part of the trees numerous young shoots would issue, much in the same manner as they do from the cut part of those trees which have been over-pruned.

934. It is now a well-ascertained truth among all practical foresters, that when a young tree is in a vigorous state of growth, and the wood full of sap, previous to its having made any heartwood, any branch may be taken off without doing the least injury to it. It is, therefore, just at this stage of the existence of a tree that it can with certainty be made to do well or otherwise according as it is attended to—to give the top the lead in the growth—to check the stronger branches—and to give the tree that shape it may be desired it should have when it attains full age.

935. When young hardwood trees have been pruned in the manner above recommended, and after they have been planted and grown in their permanent situation for the space of three or four years, they will by that time have established themselves properly in the ground; which circumstance is known by their putting forth considerable shoots of young wood. At this stage of their growth it will be necessary to go over them all with the pruning-knife, and cut close to the main stem or trunk all the parts of the branches that were formerly shortened, and, at the same time, to shorten back all other branches that may have gained strength, or may have the appearance of gaining strength, upon the top or main shoot. But it should be particularly observed, that this pruning ought never to be allowed to be done until the young trees have decidedly established themselves in the ground, and are in a vigorous healthy state of growth. At the same time, any unhealthy plant which may not have succeeded well, should be cut over, when it will soon rise up with renewed vigour.

936. I have now given a statement of the manner of proceeding with pruning operations, in the case of young trees about to be planted out into the forest; and also the treatment they ought to receive after being three or four years established in the ground. There may, however, be—and, indeed, too often are—cases where hardwood trees, while young, have been entirely neglected. It will now be proper to consider the treatment that such ought to receive. I shall first suppose that we have to do with a plantation of young hardwood trees, which had received no pruning at all previous to being planted; and I shall further suppose, that the trees are oaks, and of five or six years' standing in the forest grounds. On examining the state of young hardwood trees of this description, it will be observed, if the situation be an exposed one, that the greater part of them have died down to the part resting upon the surface of the ground, and that from this part a number of branches have issued, each contending for the lead in the growth. In such a case as this, no time should be lost in giving the strongest and most healthy shoot the preference, and cutting away all the rest, as well as the dead part of the tree nearly by the ground, or at least down to the part where the young shoots issue. Prune up the

shoot intended to be left for the future tree, by taking off all the stronger branches clean to the stem; and in this manner go over every young tree in the plantation, always choosing the most healthy shoot for the future tree, and one which appears to have naturally a good balance of branches, with the leader or top shoot strong in proportion to the rest.

937. I shall again suppose a plantation of oaks, of the same age as the one above alluded to, but the trees in which, instead of having been planted without pruning, have been pruned too severely when lifted from the nursery ground, and previous to being planted. The treatment in this case must in every respect be the same as in the former; that is, all the dead wood should be cut away immediately above the point from which the young shoots issue; and the strongest and most healthy shoot being fixed upon for the future tree, it must be properly pruned up, by taking off all the stronger branches, and shortening the rest of the shoots. But in a case of this nature, where the trees had been over-pruned previous to their being planted, there is often more difficulty in making choice of a good young shoot, than where no pruning at all had taken place. This arises from the young shoots springing from the main stem in a horizontal manner, and that, too, very often a considerable way up the stem. In a case of this nature, where a proper leading shoot, rising perpendicularly, cannot be got, the only way, and the method I always follow, is to cut the main stem by the surface of the ground, and allow a set of new shoots to rise up. The chance generally is, that, when the tree is thus cut down, all the new shoots will rise in an upright position, and a choice can be afterwards made: but wherever a proper leading shoot can be had, let it be chosen, although it come away rather far up upon the stem. If it rise perpendicularly, and the plant be in a vigorous healthy state of growth, it will succeed well. This sort of work should be done in the spring months, so that the growth may set in immediately after the operation is performed.

938. It very often happens that a forester, upon entering a new situation, finds that the several plantations which are put under his management have been hitherto much neglected: he finds that, in many cases, pruning is absolutely necessary, but he is at a stand to know how to proceed. If he be a man possessed of only small information on the subject, and one who has not had much practical experience, he is very apt to go wrong in a case of importance. He looks upon the trees before him, and is, no doubt, aware that pruning is necessary to their health; but, in consequence of some particular circumstance connected with the trees with which he has to deal, he finds much difficulty in making up his mind as to the manner in which he ought to proceed. If, however, he should be a man of

considerable knowledge, and who has had extensive practice, he will look back upon his former experience, and consider where and when he had to deal with a case resembling the one that may be before him. If he has, he will review the manner in which he went to work in it; and, at the same time, he will consider the consequences that attend such operations, whether these were beneficial or not; and, in all cases, he will endeavour to govern his conduct in pruning operations by the result of his past experience. Whatever method of operations he has known to succeed well, he will put again in practice, according as the nature of the case may require; and whatever method he has found to have been followed by injurious effects, he will avoid, except in particular cases, where he is aware it would answer the end desired.

939. With regard to the pruning of forest trees generally, all would be simple and well, provided a distinct practical rule were attended to, both by proprietors and foresters, for the rearing up of plantations at every stage of their growth; but in practice, the case is almost always the contrary. No distinct practical rules being adhered to among foresters as a body, one goes to work in one way, and another in a contrary way, in the same piece of work; and in the manner of doing the work all depends upon the knowledge and practical experience of the man. A man of high intelligence in his profession, and of sound practical experience, finds out for himself what ought to be done, and guides himself in the execution of his work accordingly; but the man of small knowledge and experience, unless he has some definite rule laid down to guide him, will go to work merely under the direction of his own judgment, whether that may be right or wrong; and if his master, the proprietor, has not himself a knowledge of how the work ought to be done, matters will often go very far wrong indeed; even so much so, that the greater part of the plantations upon an estate, if not ruined, are made of very little value. We very frequently see plantations upon an estate over-pruned, while those upon a neighbour-one are not pruned at all; which at once points out the bad management that exists relative to forest operations in general.

940. In one place where I acted as assistant-forester, I had a most convincing proof of the want of a practical rule among foresters as a body relative to pruning, and which told me at once that they have hitherto acted in such matters more according to their own private judgment than upon any well-founded scientific rules. When I went to B—— as under forester, I found the head forester an old man, who had reared up most of the plantations upon the estate; and the situation being in a high and exposed part of the country, he had never either pruned or thinned much; in fact, in most cases pruning had never been practised at all,

from the idea that the baring of the trees of their branches would diminish the shelter which they were meant to produce. Many of the plantations consisted principally of a mixture of ash, elm, and plane trees; and from the circumstance of the firs having been cut out pretty early, the trees were low-set and spreading in the habit of their branches, never having been much drawn up: they were about thirty years old. Shortly after I went to this place, the old forester died, and a young man was appointed in his place. The proprietor wishing to have his plantations improved, and having no knowledge of how the work ought to be done himself, he, of course, left the whole management of them to his forester. The new forester set about the pruning and thinning of some of the plantations at once, and a number of men were set to accomplish this. I was appointed one of the pruners, and my orders from the forester were to prune all the trees left standing upon the ground, and to give every tree a clear stem to one-half its entire height. The trees being generally from twenty-five to thirty feet high, we gave each tree a clear stem of from twelve to fifteen feet from the ground. In doing this, we had often to cut off large branches from the boll as thick as itself, which gave the trees completely the appearance of having been manufactured artificially; and, having been very thickly set with branches all along the trunks, when they were pruned the entire trunk was a surface of wounds. With regard to the tops of the trees, our orders were not to do anything excepting where two or more tops appeared to strive for the preference, in which case we left only one, cutting away the others. Having left that place shortly after this operation of pruning had taken place, in five years after I went to visit it, in order to draw for my own private instruction a lesson of experience, by observing the effect of the former severe pruning upon the trees: the consequence was exactly that which I anticipated in doing the work. On looking over those plantations, the ruin of which I had assisted in bringing about, I felt sorry to think that gentlemen should be imposed upon by inexperienced men. All along the boles of the trees, and about the wounds which had been made in the cutting off of the large branches, young shoots had sprung out. The trees were generally now hide-bound, from having been suddenly exposed and the atmosphere cooled about them. The trunks had scarcely increased anything in girth since they were pruned, and the top branches had made little or no wood. The trees, generally speaking, were ruined in their health, and all hope of their recovery was gone. From this example, I had indeed a lesson of experience for my future guidance, and I have detailed it here in order that it may be a lesson to others also. The question now comes to be, whose mismanagement had been the cause of ruin in the case alluded to? Whether was the blame attributable to the old forester, who neglected to prune and train up the trees as he ought to have done, or to the young man who succeeded him, and pruned them without due consideration and experience? In my opinion they were both to blame; for, had the old forester pruned and thinned in due time, all would have been well in the end; and had the young forester had more knowledge and been more cautious, and pruned and thinned gradually, all might have been well also. The practical truth that I wish to enforce from this instance of mismanagement is, that in every forester great caution, combined with sound practical experience and reflection, are necessary before he commences to thin or prune any plantation. From the temporary nature of the crops which they raise, although the gardener or farmer mismanage any of their crops, all can be redeemed in the course of another year; but in the case of mismanagement in a forester, the work of past years is lost, and thirty or forty years, with a considerable outlay of extra money, may possibly not be sufficient to redeem what is put wrong.

941. Having given the above example of mismanagement, in order to point out the necessity of using caution in entering upon pruning operations, I shall now proceed to give a few examples of the manner in which I have gone to work in similar cases of neglected plantations; and I am convinced that, wherever plantations have been neglected as to pruning, if they are under thirty years old, they may, if dealt with as I shall here point out, be recovered, so far as to make profitable timber trees, although probably not to that extent of value that might have been expected had the same trees been properly pruned and trained up in their young state.

942. When I went to act as forester upon the estate of Arniston, I found that many of the hardwood plantations under thirty years old had never been pruned at all, and that there was great need for means being used as quickly as possible to put these into a proper state. In setting about this part of our forest operations, I determined to begin with the younger part of the woods, as being most likely to recover quickly, and to be of the most value ultimately, if taken in due time, and to go on with the pruning of the older districts of plantations as I could find convenient opportunity. Having laid down this principle as a rule of procedure, I commenced first upon a plantation of oaks, about twelve years of age—which plantation, I saw, had never, up to the period I commenced upon it, been either thinned or pruned. The first thing I did, was to go carefully over the whole, and examine most minutely its state, observing, in a particular manner, whether or not the situation was exposed. Being convinced, from the general bear-

ing of other plantations in the neighbourhood, that the situation was rather sheltered than otherwise, I determined upon thinning out the firs pretty freely from among the young oaks. Having done so, and had the firs all cleared off which were cut, I found that the young oaks had been a good deal crushed down by the firs, which had grown very freely as compared with the oaks; and in consequence of having been thus crushed down, many of the latter had grown strongly to side branches, and not to height; but wherever the oaks had had free top room, with firs rather close upon their sides, they were tall plants, and generally well shaped. The average height of the oaks was from five to eight feet; the bark of the trees was clean and fleshy; and, generally speaking, they were in good health. In the pruning of those trees, I first had all the small branches, not exceeding two-thirds of an inch in diameter at their base, cut from the stems, and close to the bark, to the height of about one-third of the tree in each case. Next, all branches which grew upon the same part, with a diameter at base exceeding the last mentioned, I cut off to within about four inches of the stem from which they proceeded, leaving the bases in the mean time; and all large top branches, which appeared to be gaining strength upon the leading shoot, I shortened down to nearly one-half of their whole length; but in all cases where two top shoots appeared, I cut one of them closely away, always leaving the one which appeared to be the most healthy and strong, and which at the same time appeared to come most directly from the centre of the system of the tree.

But I must observe here, that in the pruning of a young hardwood plantation all the trees do not require to be pruned to the same extent: in many instances it will be found that pruning is not necessary at all; and so it was in the case of the plantation I am referring to. Wherever a hardwood tree is drawn up rather closely among firs, with sufficient head-room, it seldom produces many side branches, but will grow upwards to the light; therefore, in all cases of pruning, where the side branches upon a young tree are few, let such remain, and merely shorten them down where they are long and slender. Pruning is an unnatural operation, and ought always to be avoided unless absolutely necessary; that is, it ought to be avoided wherever the tree does not produce unnaturally strong side branches, excepting so far as to clear from branches one-third of the height of the tree from the ground, in order to form a clean trunk; and even upon this part, where the branches are large, they ought to be taken off gradually, as already noticed. Having gone through this plantation in the manner above described, I allowed it to remain so for the space of two years; when I again went through it a second time, and pruned in the following manner all the oaks that stood in need of it.

943. Having taken out a few more of the firs, which I observed were rather encroaching upon the young hardwood, and having examined the general state of the latter, I found that they had thriven remarkably well during the two years since I pruned them. From being relieved of a superfluous and unnatural weight of side branches, they were growing tall, and in a generally healthy and rapid-growing state; therefore, seeing this, I cut close to the main stem or part which formed the trunk, all those stumps or bases of the branches which I formerly shortened to four inches; and in regulating the tops of the young trees, I merely shortened such shoots as had the appearance of ultimately gaining strength upon the main top shoot. With regard to my reason for not having cut away the strong branches from the main stem when I first pruned those trees, I have to observe, that had I cut them away at the first course of pruning clean to the bark of the trunk, the consequence would have been that the sap of the young trees in its ascent would have been arrested at the cut parts, young sapling shoots would have been formed upon the stem immediately under the cuts, and the general health of the trees would have been injured from the sap not rising unchecked to the top shoots. These evils were avoided simply by cutting off a considerable portion of each large branch, and leaving a small portion of each upon the stem, in order to continue the regular flow of the sap to that part, and which, from being partially weakened in the branches, was proportionately forced to flow upwards to the supply of the top parts of the trees. After this had taken place, the stumps were cut away, without doing any injury to the trees. By this method of pruning off parts of large branches from a tree, I have often brought unhealthy trees to a state of sound health; and as soon as I observed that such trees had regained their health, which is at once observable by their making vigorous shoots of young wood in the top branches, I immediately cut away the parts of the branches that were left, when the wounds were soon made up by the extra supply of proper woody matter, which increased with the health of the trees. This cure, however, is only applicable to trees in a young state: I have succeeded in effecting it upon trees under twenty years old.

944. After pruning the oak plantation in the way just detailed, I next set to the pruning of another of about twenty years' standing. This other, also of oaks, was situated in a rather sheltered part of the estate; and from having been nursed by Scots pine, many of which were growing when I commenced pruning operations there, the oak trees were very much drawn up. I observed that the oaks had never been either thinned or pruned, and consequently the trees were growing within four feet of one another; that being the distance at which they had been originally planted. As the situation was a sheltered one, I thinned out a few of the Scots pine, and also a few

of the inferior oaks, previous to commencing to prune. When I had those removed, and the trees standing more upon their own weight, I saw that they were, from the effects of having been drawn up, very slender, and not able to stand much exposure or much cutting in the way of pruning, although they were from eight to fifteen feet in height; I therefore only shortened a few of the stronger side branches below, and at the same time shortened a few top branches upon each tree as I found it necessary, in order that they might be properly balanced, and that the wind might not have much power upon them. In this state I left them for two years, when I again examined the trees, and finding that they had improved in a remarkable manner, I again set to work and gave them a final pruning. I have seldom found any plantation make such an improvement as this one did during these two years. This was owing to the gradual manner in which I thinned out a few trees, and cut off a part of the branches as a preparation for pruning. This is what every forester ought particularly to attend to; for, had I foolishly and thoughtlessly commenced to prune severely at first, it was quite possible that every tree in the plantation might have been thrown into an unhealthy state,—which, indeed, I have more than once seen done; but by having gone cautiously to work, I had the satisfaction, at the end of two years from the time that I first examined those trees, to find them not only stiff, healthy, tall trees, but in a most vigorous state of growth also. I now pruned them upon the same principle as stated in the former case; that is, I removed off all the branches to one-third the height of the tree in each case, in order to form a clean trunk; and above this, among the top branches, I merely shortened such as had the appearance of gaining strength upon the top. And wherever two distinct tops occurred in one individual tree, I cut off one, always leaving the one which appeared the most strong and healthy, and which issued most directly from the centre of the system of the tree, although in many cases it did not take an upright direction; for, let it be observed, an oak tree is the more valuable for having a bend in its form, such trees being useful in ship-building. I very lately examined the condition of this plantation on the estate of Arniston, and have great satisfaction in reporting that the size of the trees at the age, and their generally sound, healthy state, is not to be surpassed by any plantation of oak I have seen since I pruned them,—fifteen years ago,—which gives me full confidence in recommending to others a mode of pruning which was of so much benefit to them.

945. In the pruning of all young trees, any branch of which may be got at by a man standing upon the ground, which branches, generally speaking, will not be more than one inch in diameter, the work ought to be done

by the common forest pruning-knife. (See Fig. 126.) This is not made with a hinge between the blade and the handle, as is the case in common pocket-knives, but the blade is fixed into the handle. The blade is also made straight in the face; that is, without any hook at the point, as is the case with garden-knives. The forester, in working with this knife, when he has no occasion to use it, puts it into a sheath of leather hanging by his side. In cutting off any branch of a tree from its stem with the forest pruning-knife, the operator takes hold of the branch with his left hand a little forward from its base, and eases it upwards, and at the same moment he applies the pruning-knife with his right hand to the base of the branch to be cut off, cutting it upwards in the same line as the stem of the tree—taking care not to enter the knife upon the plane of the stem of the tree, but a little upon the base of the branch to be cut off, say about a quarter of an inch upon the rise of the wood forming the base of the branch. By this means the stem of the tree is not injured, and, at the same time, the damp is thrown off the wounded part. In all cutting off whole branches immediately from the stem of a tree, the wounded part should be made perfectly smooth, paring it neatly all round with the knife, which should be kept very sharp. When the work of lopping off a branch is finished, the part will have the appearance as represented in Fig. 127 at *a*; and in the course of two years after being done, the wounded part will be entirely covered over with young wood,—that is to say, if the subject is in full health.

FIG. 126.

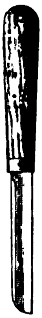
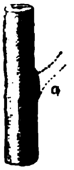
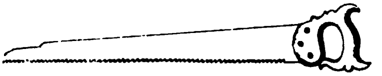


FIG. 127.



946. When pruning operations are done upon a tree, the branches of which are within the reach of a man standing upon the ground, but which are too large for being easily cut off by the pruning-knife, the pruning-saw must be applied. (See Fig. 128.) In all cases of cutting off a branch with the saw, care must be taken, first, to make a slight cut with it upon the under part of the base of the branch to be taken off, say about half an inch deep if the branch be three inches in diameter, and so on with any other size of a branch in proportion. This is in order to prevent the branch, when nearly cut through, from falling away suddenly and tearing away the bark below its base upon the stem, which circumstance sometimes happens with careless hands. Care should be also taken to pare with a sharp knife all the wounded surface made by the saw, which is always rough. By attending to this, the damp will not be so apt to lodge upon the wound.

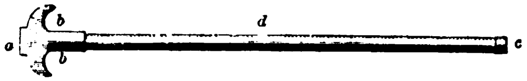
FIG. 128.



947. Where the operator cannot reach to the branch to be taken off, and

where, of course, he could neither use the pruning-knife nor the saw, the *pruning-chisel* is used. (See Fig. 129.) In this instrument, the handle *d* may be of any convenient length to suit the height of the tree to be pruned; and it should always be made of a piece of good tough well-seasoned ash-wood. In using the instrument, the operator takes hold of the handle with his left hand, and puts the sharp face of the instrument *a* to the under part of the base of the branch. He then, with a mell in his right hand, with one or more strokes upon the lower end of the handle *c*, which has an iron *virl* or ring upon it, forces the instrument through the branch, and separates it from the stem of the tree. In the act of doing this, care should be taken to repeat the strokes lightly when the branch is nearly through; because, were a heavy stroke of the mell given at this time, the instrument might be forced upwards and injure the stem of the tree, making a deep cut. When it is necessary to take any part of a branch off which may be considered too long and not in balance with the tree, the hooked parts of this instrument, *b b*, are used. They are kept very sharp on the inside; and in taking off any part of a branch with them, the operator pulls the instrument suddenly towards him, by which means a pretty large branch may be cut very quickly through. In using the pruning-chisel, a considerable deal of practical skill is required; and in the hands of a practised man, it is a most effective instrument. I have had workmen who, with a single stroke of the face *a*, upon any branch three inches in diameter, could force it through in a clean and neat manner; and of course this was in favour of the health of the tree so pruned; for the less haggling there is in taking off any branch of a tree, the less is it injured, and the more healthy is the result.

FIG. 129.



948. All pruning operations should be done in the spring or summer months, observing to leave all maples till the summer season. I would not advise to prune any after the 1st of August, for after that time the motion of the sap becomes slower, and the wounds are consequently longer in healing up. I have this season (1859) pruned extensively from the end of April to the end of July, and have found the results most satisfactory. I observe that those trees which were pruned in May and June heal up in their wounds much faster than those done in July or a week in August. My impression, therefore, is, that the month of June is to be preferred to any other month in the year for this operation. In pruning oak trees in the month of June, the bark can be taken from such branches as are of any size; and I have found this to be a source of profit in forest management.

SECTION II.—PRUNING AS APPLICABLE TO CONIFEROUS TREES.

949. The pine, the fir, and the cedar, but especially the trees of the two former families, from their natural strong tendency to shoot upwards in the form of one leading stem, with comparatively small lateral branches, are seldom found to require any such pruning as is generally found necessary for trees of the hardwooded species. But even in such specimens of the coniferous trees as do happen to grow strongly to side branches, and which, on that account, require to be checked in order to give the trees a more upright habit, a different mode of the operation of pruning must be resorted to from that generally applied to the hardwooded sorts. I have found that the amputation of healthy limbs from trees of the pine, fir, and cedar, at least to any considerable extent, is highly injurious to the health of the subjects, from the wounds bleeding for years after they have been made, and thus causing a great loss of the sap. A live branch removed from the stem of a young oak or elm, in the season of its growth, bleeds very little indeed, and the wound heals up shortly after; but if one be removed from the stem of a pine or a fir at any season of the year, the wounded part will continue to bleed for a very long time; and in many cases I have known it not to heal at all, but to cause the death of the subjects. In pruning coniferous trees, therefore, the removal of live branches from their stems should be avoided.

950. Trees of the pine and fir tribes, from their natural tendency to congregate together in masses, and from their being generally planted closely in our artificial plantations, are seldom found to require the pruning-knife to shorten or remove their branches, as from these being checked in growth by their standing close to one another, the necessity for this is obviated.

951. Although, however, the natural tendency of these tribes is to grow in masses, and although, when we plant them under such conditions as nature would seem to direct, we seldom or never find it necessary to check their branches by pruning; still, when they are grown far apart from one another, as is the case in the greater part of the *pinetums* of this country, they naturally send out such strong side branches as to deprive the leader, or main stem, of the amount of sap it requires to enable it to shoot proportionally upwards; and to render it necessary that we should apply some mode of pruning to check this overgrowth of the branches.

952. From the fact that the removal of live branches from the stems of coniferous trees is highly injurious to their health, we should upon no account remove such, but adopt some other mode of pruning, and such a mode as will not necessitate the amputation of limbs, but merely act as a

check upon the individual branches that seem to strive for the mastery with the leader or main stem. This is most completely done by merely stopping the points of the too luxuriant branches.

953. Where, then, it is found desirable to grow specimens of coniferous trees, singly, and so far apart from one another, or from other trees, as that the overgrowth of their side branches cannot naturally be checked by others standing near them, the points of the branches that seem to grow too luxuriantly should be *pinched off* with the fore finger and thumb, only to the extent of an inch or two, at the commencement of the growing season. This attended to while the trees are young, and before they become of a confirmed branchy habit, will have the desired effect of checking the flow of growth to such large branches, and of throwing a proportionately greater amount of the sap to the centre of the system for the benefit of their stems. This is all that is necessary in order to gain the end in view, namely, to give the leading stem the ascendancy of growth over the branches ; and if this simple treatment of the branches is regularly attended to for a few years, the specimens so dealt with may be made to assume quite their natural characters.

954. As a rule, the more healthy and vigorous in growth any tree is, the more its growth is naturally directed to the stem, the more clothed it is with proportionate branches ; and, therefore, the less necessity there is for pruning. This rule I am confident in stating to be generally applicable to all trees, both *resinous* and *non-resinous*. I maintain, therefore, that where much pruning is found necessary to put trees into a proper and natural shape, it is an evidence that the subjects have not been dealt with according to the natural laws that regulate vegetation, and that their management has been faulty. This of course may arise from various causes, but chiefly from unsuitable soil, from wetness in the subsoil, and therefore the want of proper drainage ; and from planting on situations not adapted to the nature of the trees.

955. I have for some years adopted the mode of stopping the points of the strong branches of my specimens of the newer sorts of pines, firs, and cedars ; but I never do it except in such cases as I find require it. Where the stems take the lead in a natural and decided manner, and when the branches show no tendency to become over strong, nature requires no assistance, but performs her own work ; so that in thus recommending to prune after the fashion I have described, I mean that it should be done only when necessary.

956. I seldom find the Scots pine, the larch, or any other of the perfectly hardy species of coniferous trees require any assistance in this respect ; but I frequently find it necessary to assist the different species of

cedar, and the newer pines and firs; more especially where I have them planted on somewhat exposed parts, and where, consequently, they are of comparatively slow growth. Any treatment of the sort is, however, only necessary in the earlier stages of the trees. If they are attended to while young, and until the leaders have gained the ascendancy, no further attention is wanted.

957. Another point which falls to be considered here in reference to the pruning of coniferous trees is, that of clearing them of *dead branches*. In examining our pine and fir plantations in this country, it is evident that we err in not clearing the trees, as they grow up, of all dead branches—as they die and become useless to the economy of the trees. The leaving of these to rot upon trees is injurious to the health of all classes of them, as well as deteriorative to the quality of their timber, inasmuch as each layer of young wood, as it is annually laid on the stems, encloses in it a portion of the bases of the dead branches, which never can adhere with the healthy wood, but remains to rot and to injure the quality of the timber. I recommend, therefore, that as the lower branches of the coniferous trees gradually die out—and in plantations they always do—they should be as gradually removed. Were this attended to, our woods would not only present a more pleasant effect, and be more healthy, but, what is of perhaps greater importance, would be more valuable in their timber at all stages. Many proprietors I know have done this for years past in all their plantations, both hardwooded and others, and the advantages derived from it are evident on the crops, compared with the state of other plantations of similar ages, but which have not been attended to in this respect.

CHAPTER VII.

SECTION I.—THE NATURE AND NECESSITY OF THINNING PLANTATIONS.

958. THINNING is one of the most indispensable operations in arboriculture. The right understanding of its nature and design forms one of the most important points to be aimed at by every practical forester.

959. The object which ought to be aimed at by the forester in the act of thinning, is the regulating of the trees in a plantation to such a distance one from another, and that in such a manner as is, from well observed facts, known to be favourable to the health of each tree individually, as well as to the general welfare of the whole as a plantation.

960. In order to grow any plant to that size which the species to which it belongs is known to attain under favourable circumstances, it is necessary that it have space of ground and air for the spread of its roots and branches, proportionate to its size at any given stage of its growth. Upon this the whole nature and intention of thinning plantations rest.

961. It is much to be regretted that there does not exist, both among proprietors and foresters, a sounder knowledge upon this subject than there is. I have frequently seen plantations upon a high situation going back from having been injudiciously thinned; and in a low one, I have as often seen them doing so from not having been thinned at all. Where the blame rested I know not, neither is it my business to inquire into that, but in all such cases there is evidently bad management.

962. There are, indeed, few proprietors' estates in Britain upon which there is not considerable room for improvement, as regards the thinning of their plantations. There is a decided loss of timber, as well as shelter, whenever plantations are made too thin; and there is also equally a loss where they are not sufficiently thinned. Wherever plantations have remained long in a close state, and are thinned suddenly and severely, which I term injudicious thinning, they are at once cooled. This I reckon equal to being removed a few degrees of latitude further north, or to a situation a few hundred feet higher than the original; and the natural consequence is, that the greater part of the trees which have undergone

such treatment, become what is generally termed *hidebound ;* the bark contracts, and prevents the free flow of the sap, consequently it stagnates and breaks out into sores ; the trees fail to make wood ; and, in fact, the whole plantation falls into a state of consumption, and declines gradually. I have frequently been called upon to examine and give my advice relative to what ought to be done with plantations in such a state as that described above ; and wherever I have found plantations above thirty years old to be so, and to have stood in the same state for four or five years without showing much signs of improvement, I have always recommended to cut down at once, drain, and replant the ground. However, if the situation be a rather sheltered one, and the soil dry, a recovery of an over-thinned plantation will often take place ; although the trees, after having been checked, will never attain that size they would have done had they been otherwise treated ; but where the situation is exposed, and the natural soil cold and damp, recovery is hardly possible.

963. On the other hand, where plantations are not sufficiently thinned, the trees become drawn up weakly, and seldom attain the size of useful timber before maturity comes upon them. Where any plantation has stood long without being thinned, particularly a fir one, it is, I may say, impossible to recover it ; for if even a very few trees be thinned out, a number of others, from the want of their shelter, are sure to die, which ultimately causes blanks to occur here and there ; and the wind getting play in such blanks, great havoc is often made among the trees during a storm. As an instance of this, I may here mention the case of a fir plantation upon the estate of Arniston, of above thirty years' standing, and to the extent of nearly forty acres. This had been allowed to grow on in its natural state from the time that it was planted, when an attempt was made to take a few trees out of it, by way of thinning it gradually. This having been done, many more were blown down the very first storm that occurred ; and an opening having thus been made by the wind, the whole plantation in a short time became a complete wreck ; so much so, that when I came to the place, I had the whole cleared off and replanted ; and since leaving Arniston, I have seen many plantations which had to be cleared from the same cause.

From what has been here stated, it will appear evident that there is a great loss sustained by every proprietor who allows his plantations to be mismanaged, either from not thinning, or from over-thinning ; and the result may be reckoned the same in both cases.

964. Upon many estates, I have often regretted to see plantations of considerable extent, and of perhaps forty years' standing, with the firs all overtopping and crushing down the hardwood trees. From the appearance of such plantations, it was evident that they never had been thinned. The

hardwood trees were miserable-looking things, and not more than ten or twelve feet high, striving for existence; while the firs, which of course grew more rapidly, were more than thirty feet high, and of a broad spreading habit, from having been widely planted among the hardwood. In this state many plantations have been allowed to grow up, under the false impression that the firs were of more value than the hardwood for the sake of shelter.

Now, could any circumstance be a more convincing proof of the want of sound knowledge relative to thinning? If the hardwood trees had been relieved in due time, would they not at forty years' standing have been valuable, both as timber and as affording shelter? Could not the firs have been all taken out for estate purposes, and been of value to the proprietor, while at the same time they left a more valuable crop of hardwood on the ground? But, as the case was, the hardwood plants were useless and past recovery; and upon the ground where a valuable crop of hardwood might have been, there existed only a few firs of little permanent value, either for shelter or as timber.

965. The distance at which trees in a plantation ought to stand one from another, must, in all cases, be determined by the nature of the soil and situation upon which the trees grow, and also by the ultimate object the proprietor may have in view as regards any particular plantation. As a sort of guiding rule for thinning, I may here state, that if in any particular plantation it should be intended to rear up trees for park or lawn scenery, then, in such a case, the distance between each individual tree ought to be at least equal to the height of the same; and this rule ought to be kept in view at all stages of growth after the first thinning has taken place, in order that they may have free room and air to form spreading tops as well as massive trunks, which is the true and natural form of every tree, and which constitutes the great beauty of lawn trees.

966. If it should be intended to rear up a plantation of hardwood trees principally for the sake of value of timber, and for giving shelter at the same time, in such a case the distance between each individual tree ought to be equal to about one-half its height. This ought to be kept in view at all stages of the growth of the trees, after the first thinning, in order that they may not have so much free air and room as to allow of the spread of their branches horizontally, while they are not so much confined as to be drawn up weakly from the want of air. If it is intended to rear up a plantation of firs or pines for the sake of shelter and timber, the distance between each tree ought to be a little more than the third of the height, which is the distance found most favourable to the useful development of the fir and pine tribes as timber trees.

967. In order to give a clear and practical description of the manner of proceeding with thinning operations in the forest, it will be necessary to treat of them under distinct heads; and this I shall do in the proper place. It may, however, be useful here to observe, that all plantations, ere they require to be thinned, must have grown for at least eight years; and even this period may in most instances be far too early. In fact, no particular period can be specified as to the length of time that a plantation should stand previous to commencing to thin it; for much depends on the nature of the soil and situation—on whether or not a plantation may have been well laid out—and on the state of the ground, as being dry or damp. These things considered, it will appear evident that no particular time can be stated as to when a plantation should be thinned for the first time, but that this must be judged entirely from the state of the trees, whether they may have grown rapidly or not. I have found it necessary to thin a young plantation of seven years' standing, at which age the trees were twelve feet high; while, on the other hand, I have much oftener seen plantations of fifteen years' standing, scarcely the length of requiring to be thinned: therefore, observation upon the spot is the only sure way of determining this point.

SECTION II.—HOW TO PROCEED SYSTEMATICALLY IN REGARD TO THE THINNING OF PLANTATIONS ON ALL WOODLANDS.

968. Although it is admitted that after properly adapting a crop of young trees to the soil suitable to it, *systematic thinning* has the next greatest influence in bringing it to a satisfactory result, yet it is seldom such thinning is applied; and although I have within the last ten years examined, professionally, woodlands to the extent of upwards of two hundred thousand acres, and this upon various properties, both in England and Scotland, I have only seen systematic thinning applied in two or three cases at most.

969. Even at the present day there are few foresters who understand and can apply systematic thinning to the woods and plantations they have the management of; and to the want of this knowledge is very much to be attributed the great extent of inferior crops we find in plantations in all parts of the country, upon all descriptions of land, and on large and small properties alike.

970. Even in the Government forests, where we should expect to find trees managed in a manner in advance of the age, I found that systematic thinning had never been applied, and that the operation had been con-

ducted without rule, and by starts, as seemed proper to the superintendents at the time. If such a state of things was carried on in the national forests of our country, it is hardly to be wondered that a similar state of things should exist on private properties.

971. I stated in paragraph 969, that to the want of a proper understanding of systematic thinning among foresters of the present day, is to be attributed the want of its application to our woods, and that this is in a great measure the cause of the inferior crops we find on a large extent of our woodlands. This is not to be doubted, as wherever systematic thinning has been applied, the crops so dealt with are nearly of double the value, at a given age, as compared with others that have not been attended to in a similar way, circumstances of soil and climate taken into consideration.

972. On all the properties, respecting the woods of which I have reported, I have invariably recommended as a means of improvement, that the several ages of plantations should be divided into equal portions, and that one such portion should be periodically and systematically thinned—once in three, four, five, or six years, according to the ages respectively. Wherever this system has been intelligently put into operation, it has been attended with the greatest possible advantages to the crops; not only making them more valuable from their being kept in superior health, but also to a large extent lessening the expense of labour, and therefore causing a greater amount of clear revenue to be derived from them than could be drawn under the former and unruly state of their management.

973. The scheme of systematic thinning which I have referred to, which I adopt in the management of the woods of which I have the charge, and which I recommend to others, may be shortly described by reference to a statement in illustration. In order to this, and to make the scheme as clear and intelligible as possible to all classes of foresters, I shall take up a case of the woodlands on a supposed estate; say on one on which there are plantations of various ages, extending to 3225 acres in all. The statement, then, is as follows :—

974. STATEMENT showing the Extent, Age, and Character of Crops of the Plantations on the Estate of WOODLANDS, in the County of —— as in 1860.

Names of Plantations.	Description of Crops.	Age in Years.	1. Extent under 25 years.	2. Extent above 25 and under 35 years.	3. Extent above 35 and under 45 years.	4. Extent above 45 years, and under 60 years.
			A. R. P.	A. R. P.	A. R. P.	A. R. P.
Redbraes, . .	Oak with Larch as nurses,	10	304 2 ...			
Greenhills, . .	Larch and Pine,	32	... ...	236 1 20		
Stanford, . . .	Oak,	50	... ...	... ...	... ...	480 ... ...
Raeburn, . . .	Larch and Pine,	43	... ...	... ...	208 2 20	
John's Wood, .	Ash,	...	... ...	36 3 ...		
Lead Hills, . .	Larch and Pine,	20	409 3 ...			
The Grove, . .	Oak, Sycamore, and Elm,	58	... ...	... ...	... ...	79 1 ...
Tom's Meadow,	Oak,	40	... ...	... ...	90	
Wallsend, . .	Oak, Ash, Elm, and Larch,	40	... ...	... ...	206 3 ...	
Nord Hill, . .	Oak with Larch,	17	305 3 ...			
Ann's Brae, . .	Larch and Pine,	30	... ...	97 1 ...		
Thuylaw, . . .	Oak,	40	... ...	... ...	225	
Bar Muir, . .	Larch,	15	90			
Revach, . . .	Pine,	50	... ...	... ...	... ...	80 ... ...
Castle Hill, . .	Larch,	20	35			
Stainton, . . .	Oak,	32	... ...	40		
Yarrow More, .	Oak,	28	... ...	60		
Eildon More, .	Larch,	25	... ...	104		
James Wood, .	Pine,	30	... ...	36		
Dunedin, . . .	Oak and Larch,	20	100			
			1245	610 1 20	730 1 20	639 1 ...

975. Having given this statement, I shall next suppose that it represents the names, the description of crops, and the ages of the several plantations on an estate, as well as the extent classified betwixt the different ages stated in the four columns, and as numbered 1, 2, 3, and 4. Here, then, I have represented four classes of plantations, according to their ages, as they require to be periodically dealt with in regard to thinning.

976. Under the first column, it is brought out that there are 1245 acres of a class under twenty-five years of age. As the crops of the ages represented under this head are understood to be in a rapid state of growth, and the trees standing comparatively close to one another, more frequent thinnings are necessary, in order to keep them in a healthy and promising state, than are requisite with others at a more advanced stage. In dealing with this class, therefore, I divide the several plantations embraced in it into three as nearly as possible equal portions, and thin one such portion regularly and systematically each year successively. That is, suppose that the first portion was thinned in 1860, I would thin the second in 1861, and the third in 1862, so that in the year 1863 I would again thin the portion

which was operated on in 1860; and so on with the other portions successively.

977. Under column No. 2 it is brought out that there are 610 acres 1 rood 20 poles, of ages between twenty-five and thirty-five years. This class, from its being understood to have been well thinned while of the age of the class No. 1, and from the trees constituting it not being so much disposed to grow to the spread of branches, as to the increase of timber in the stems, does not require to be so frequently thinned as class No. 1; and I therefore lay it down as a rule, that a judicious thinning once in each period of four years is enough for it. For this reason, then, I divide the plantations of this class into four as nearly as possible equal portions, and thin one such portion each year successively, as has been described in reference to class No. 1.

978. Again, under the third column, it is brought out that there are 730 acres 1 rood 20 poles, under a class of plantations of various ages, betwixt thirty-five and forty-five years. The trees of this class being older than those of the other two, and understood to have been properly thinned and attended to up to their respective ages, will not require such frequent thinnings as either of them; and I have therefore laid it down as a rule for my own guidance, that plantations of the ages specified only require to be thinned once in the five years. Here again, accordingly, I divide them into five equal portions, and thin one such portion each year successively, and in the same systematic and periodical way stated in reference to the other classes.

979. With regard to the class under column fourth, which is supposed to extend to 639 acres 1 rood, as at the respective ages of the crops, from forty-five to sixty years, it is understood that the trees should have attained their confirmed habits, and that they should grow comparatively little in the spread of their limbs, even less frequent thinnings will be necessary for them than for the younger classes. These may be thinned only once in the six years, and accordingly should be divided into six portions, one of these to be operated on each successive year as before.

980. It will be found that trees above the age of sixty years require very little thinning indeed; that is to say, if they have been attended to properly while in a younger state, and from this I never class them for systematic thinning, as at such an age the trees of any plantation should be set out to nearly their permanent distances. I do not mean to say that the trees in a plantation upwards of sixty years' standing are to require no attention; I only mean that they, at such age, cannot be said to come under a class for improvement by thinning, but should be in a state generally nearly independent of the operation.

981. It is of course to be understood from what has been stated in reference to the different ages of plantations classified in the foregoing statement, that as they rise in age they will fall to be classified accordingly, and to be thinned at more distant periods. That is, for example, while the plantation called Nord Hill is under twenty-five years of age, it will be thinned once in every three years; when at and above that age, and till it is nearly thirty-five years old, it will fall to be thinned once in every four years; and so on.

982. By adopting such a scheme in regard to the thinning of the plantations on any estate, every one of them receives equal attention and justice at all times, and none could get out of order, as is always the case, to the great loss of the crop, on all estates where no such system has been adopted. In my inspection of woods in all parts of the country, I saw that some such scheme for systematically thinning them was much wanted, and therefore I adopted the one just described. I have put it into operation for the last twelve years on the woodlands I have had the charge of, and have recommended it to others; and wherever it has been properly carried out, the greatest advantage has resulted to crops subjected to it.

983. It is an undeniable fact that the weakly, unprofitable, and therefore unsatisfactory state of a large extent of our plantations, is to be attributed to the neglect of systematic thinning. Were this scheme properly adopted and attended to by all interested in the rearing of woods, we should soon have a very different class of them from what we have at the present day; in short, our woods become premature, from not attending to this point. We frequently see woods growing upon the best land, matured when only some sixty years old: this arises from neglect of systematic thinning. Not long since I had occasion to inspect woods on a property adjoining another on which a friend of mine had acted as forester for many years. The woods on the property that I inspected had not been attended to in the way of thinning, while those of the other had; and the consequence was, that the trees had become generally matured at sixty years, while those on the property my friend managed were in a rapid state of growth at the same age, and therefore still increasing in value. This is a proof of the advantages to be derived from the scheme I recommend.

SECTION III.—THE THINNING SYSTEMATICALLY OF PLANTATIONS ON SMALL PROPERTIES.

984. On comparatively small landed properties, say such as those on which the woodlands do not extend to much more than 800 acres, the ap-

plication of the scheme of systematic thinning which has been described in the foregoing section, may very properly be modified to suit them, and still have the same effect in the working. The scheme of dividing the plantations into classes according to age, is advantageously applied to woodlands of any extent; but that of again subdividing the classes, I have found most advantageously suited for the carrying out of systematic thinning where the woodlands to be operated on are extensive, say ranging from 1000 to 4000 acres.

985. In applying this scheme of systematic thinning, therefore, to the woods on small properties, I recommend that they should be classed according to their ages, in the same way as has been described under the preceding paragraphs, but not that they should be subdivided; as any subdivision of such small extents as would in these cases fall to be dealt with, would be troublesome and tedious in carrying out the operation. I shall suppose a case in illustration of the mode I recommend in regard to the systematic thinning of plantations on small properties.

986. Supposing that there are 800 acres of plantations on a property, and that this extent is classed according to age, thus:—300 acres under 25 years of age; 180 acres above 25 and under 35 years; 210 acres above 35 and under 45 years; and 110 acres above 45 and under 60 years. In order to thin these classes regularly and systematically, it is only necessary to thin the 300 acres all in one year, and at intervals of three years; to thin the 180 acres also all in one year, but at intervals of four years; to thin the 210 acres all in one year, but at intervals of five years; and the 110 acres all in one year, but at intervals of six years.

987. If, however, the plantations on a small property were all of a class under 25 years, then they could be divided into three equal portions, and one such could be thinned each year successively; or if they were all of a class above 25 and under 35 years, they could be divided into four equal portions, and one thinned each year, and so on; the great object being that of securing such a division of the plantations as to insure the whole being regularly operated on at periods according to age.

SECTION IV.—THE THINNING SYSTEMATICALLY OF PLANTATIONS ON VERY EXTENSIVE PROPERTIES.

988. When the woodlands upon an estate are what may be called very extensive, I have found it absolutely necessary to divide them into districts, and to place over each a competent forester, and treat them as separate estates. This is the only way in which the thinning operations on exten-

sive woodlands can be properly conducted and looked after; as I have found that when one man has to superintend the operations on more than from 4000 to 5000 acres, many of them are not sufficiently looked after, and consequently get partly out of order. An outline of my mode of procedure in reference to the thinning of the extensive woodlands in Strathspey, may be shortly stated in illustration of the point under notice. It is this. We have the whole of the extent embraced under woods divided into three distinct districts, over each of which we have a competent forester, whose duty it is to attend to thinning and other operations on it, as if it were a distinct estate. Thus divided, we have the plantations of each classed in the way detailed under paragraph 974, and thinned as described under the following paragraphs. By such a mode of subdivision, any extent of woodlands may be as systematically and regularly attended to as those on a small property; and, in fact, more so; as on a large scale the operations are generally more profitably conducted than on a small one, from the fact of a better class of men being generally engaged in them.

989. In the classing of the different plantations for systematic thinning, it is, of course, understood that the forester should enter them all into a book kept for the purpose, in which should be stated the dates when each was thinned; so that at any time, by looking into such a book, he can tell when each plantation was last thinned, and when it falls to be operated on again, according to its age. This is my own mode of going to work. I have found it work well; and therefore I recommend it to others.

SECTION V.—REARING UP AND THINNING OF OAK PLANTATIONS.

990. The oak being the most valuable of all the timber trees grown in Great Britain, is generally cultivated with more care and attention than any one else; therefore I consider it necessary and proper to treat of the manner of rearing it under a distinct head.

991. Three different systems of rearing young oaks are practised among foresters of the present day, each of which is advocated and upheld by a considerable number of practical men, who put each his own system into operation according as his views of the matter direct him, without paying due consideration to place and circumstances.

The three different systems are these: — First, that of sowing the *acorns* or seed at once upon the ground where it is intended the trees are to grow up and become timber; Second, that of transplanting the trees from the nurseries in the usual way, and, in one year after being planted, when their roots are established in the ground, cutting each tree over by the surface of the earth, and allowing the stock so cut to stand for two or three years, when a number of young shoots are produced immediately from the earth, strong enough to allow a choice to be made of one to stand for a permanent tree when all the others are destroyed; and, Third, the system of planting the young trees in pits, as is usually done, and allowing them to come away in their own natural way. Each of these systems has its peculiar advantages and disadvantages; and in order to point out these clearly, and in such a manner as to render the statement of them practically useful to the forester who wishes information, it will be necessary to make a few observations upon each of them.

992. With regard to the first—namely, the system of sowing the *acorns*, or seed of the oak, at once upon the ground where it is intended the trees are to grow up and become timber—this is undeniably acting according to the laws of nature, to which we ought always to attend in the rearing of forest trees. Those who advocate the general introduction of this system say that the best specimens of oak trees to be found in Britain are those sown by the hand of nature. But this assertion seems to be far from fully authenticated; for, of the many famous oaks mentioned in the history of our country as having existed until lately, it is uncertain whether they were remains of an old natural forest, or whether they have been planted artificially by the hands of man. The managers of the Government forests in England, to some extent, adopted this method for the rearing of their oak for the supply of the navy; and I understand that the trees so raised have done well, and are likely to become trees of the first magnitude; but still I am not aware that they are succeeding better than transplanted trees would have done, had they been planted instead of the acorns at the same time. I have sown acorns in forest grounds, with the view of ascertaining if plants raised in such a manner did grow much more rapidly than those brought from the nurseries and transplanted in the usual manner; and from what experience I have gathered upon this point—which, be it understood, has been but upon a small scale (upon five or six acres of ground), where they were merely intermixed among transplanted trees, the experiment being made simply with the view of satisfying myself as to the utility of the system—I am convinced that the trees raised from the acorns sown in the forest ground, grow for the first few years more rapidly than the others, and are brought into proper form with very little artificial aid as regards pruning; but I have found also that, where much game exists, as is almost always the case upon gentlemen's estates, it is almost an impossibility to get the young tender shoots of the plants, as they rise above the ground,

kept from being eaten down by hares and rabbits. Some years ago I was very much inclined to commence the sowing of acorns in all our plantations where oaks were required to be raised. Being convinced, from a former trial in another situation where I was, in which I was very successful, that they, when got up without any damage befalling them, formed the handsomest and fastest growing specimens, I was the more bent upon making another trial upon an extensive scale. Having communicated the scheme which I then had in view to an old forester of forty years' experience, asking his opinion previous to making the attempt, he advised me strongly not to sow acorns immediately in forest ground, with the view of raising trees in any new situation, until I had proved the utility of the system by sowing first upon a small scale. Acting upon his advice—for he was a man of the soundest judgment in all forest matters—I sowed acorns in pits dug by the spade for the purpose, and had the pits, in the act of making them, well cleaned from all root-weeds, so as to give them every chance of success; and the soil being a fine dry sandy loam, I calculated upon success. I sowed the seed in the month of February, and, upon looking over the ground in a week or two afterwards, I was mortified to find that rabbits had visited the fresh earth of the pits before me, and had fully one-half of them burrowed through. On looking for the acorns, I found the shells, indeed, but the mice had eaten the kernels; and on examining the state of the pits generally, I found that very few of them had escaped the ravages of vermin of some sort or other: I even caught pheasants in the very act of scraping up the acorns. On seeing all this, I was indeed thankful to my old friend, the forester, for his cautious advice, and was also happy that I did not sow extensively upon ground which was so much overrun with game and other vermin. As I had sown only about an acre of ground in the manner above stated, I could indeed easily have prevented the ravages of the larger animals, but against those of the mice there was no possible resource. Therefore, this being only a trial upon a small scale, I determined to give nature her own way in the whole business, and consequently did not go back to inspect the state of the pits in which the acorns were sown till about the middle of May, when I found great difficulty in tracing out the exact spots where they had been sown: the grass and weeds, which were natural to the soil, had grown rapidly, and almost hidden the red earth. I immediately had the weeds, &c., all cut away from about the pits, and at the same time had the surface of the pits weeded by the hand; but there was no appearance of any oaks as yet in them. About the middle of June, I again had the surface of the pits weeded, when I observed about twenty young oak plants rising upon a whole acre of ground; and before the autumn there were none left excepting two, which I protected—which are indeed doing well now, but not a great deal better than others transplanted about the same time, in the usual manner, from the nurseries.

Besides what I have detailed relative to my attempt to rear oaks from the acorn in the natural forest ground, I have also since sown in many places of our woods without digging the ground at all, merely paring away the turf from the surface slightly, and then putting in the acorns with a common garden dibble; and I did this with the view of disturbing the natural soil as little as possible, thinking that the rabbits and mice would not be tempted to burrow in the soil when they found it firm. The ultimate issue, however, was the same; for what plants were allowed to come above ground and had escaped the ravages of the mice and pheasants, were greedily sought after and devoured by the hares and rabbits when they came into leaf. Therefore, in the mean time, and until I have further experience upon this point, I am induced to think that the system of rearing oaks at once from the acorn in the forest ground, is not at all adapted to the present state of forest lands. I confess that I am convinced of the propriety of raising trees in the forest at once from the seed, in order to have the best specimens of timber trees; but it is very likely that a period of fifty years must elapse before our forest grounds are put into a proper and fit state for raising trees to advantage by such a system. Were it practicable to have all our forest ground ploughed and cleaned in the same manner as in agricultural operations, I would unhesitatingly say, that all forest trees ought to be raised from the seed at once sown in the ground they are intended to occupy; but until then, the system is quite impracticable.

993. I conclude my observations upon this head by remarking, that the *advantages* of the system in question are, that the trees so raised never receive any check in their growth, as must be the case with all transplanted trees: they grow much quicker, and come sooner to the size of trees, than those raised by transplanting; they grow taller in habit from not having their *tap roots* cut, and are seldom found to require much pruning, as is the case with the others.

994. The *disadvantages* of the system are, that the seed, when sown in a detached form in pits in the common forest ground, is extremely liable to be destroyed by vermin before it vegetates; while, after the plants appear above ground, they are in equal danger from hares and rabbits eating them over. They are also liable to be destroyed from the effects of rank-growing grass and other weeds choking them while in their young and tender state; and in order to avoid this, much expense is incurred in keeping the plants clean. Trenching the ground for the reception of the

seed would be the proper plan; but the expense of such an operation, to any extent, puts it out of the question.

995. I now proceed to the second system of rearing the oak when young —viz., that of transplanting the young trees from the nursery into the forest ground; in one year after, when their roots are fairly established, cutting them over by the surface of the earth; and when a number of young shoots are produced from the stocks, choosing the strongest and healthiest for a permanent tree in each plant.

This system is very much practised by foresters who have to raise hardwood plantations in high-lying districts of Scotland, where it is well known that young hardwood plants are apt to suffer a severe check when newly lifted from a sheltered nursery, owing to the cold cutting winds which prevail in such quarters. Indeed, in all cases, young hardwood trees which may have been reared in some of the public nurseries near large towns, when they are removed to, and planted in, a high moorland county, seldom do much good for three or four years after their removal. The whole part of the plant situated above the grass or foggage of the ground becomes stunted, and gradually dies down to within two or three inches of the surface, which part remains fresh, because sheltered by the foggage from the winds; and, indeed, if the plants are left to themselves in such a situation, they, about the second or third year after being planted, and after the roots have properly established themselves, send up a number of young shoots from the live part about the surface of the ground, which young shoots ultimately become trees of inferior magnitude; but if those young shoots be thinned out to one individual, a tree of the usual magnitude will be the result. Now, this system of cutting over is only assisting nature; and if, instead of allowing the young trees to lie dormant for three years, as is the case when left to nature, the forester cuts each tree over by the surface one year after they are planted, he places himself by his art two years in advance of nature as left to herself; for as soon as the trees are cut over, they each send up from three to six vigorous young shoots, which, when they are of sufficient age, can be removed, with the exception of one, which is left as a permanent standing tree. I have, by adopting this method, had strong vigorous young shoots of two feet high the second year after planting; while, where I have not had them cut over, four or five years elapsed before I had shoots of the same strength.

I was acquainted with a forester who had the management of extensive plantations in Aberdeenshire, who, upon receiving his young hardwood plants from the nurseries, of whatever species they were, cut each down to within three inches of the roots, and planted them in this state in the pits which were prepared for them in the forest. His reason for doing so was, that he asserted he gained young shoots a year sooner than if he had allowed the plants to remain for one year in the ground previous to being cut over, as is the usual way. But upon examining the state of his young hardwood plants, which had been planted one year before I visited him and inspected his system of going to work, I found that all his young trees, which had been so cut previous to planting them, produced but very weak shoots the first season; and, as I apprehended, they in fact made no vigorous growths till the second year. In this case, therefore, something was lost instead of gained; for until the roots of the young plants are fairly established, very little young wood can be produced. The plants require the first year in order to establish their roots; and if they are forced to make wood during that year—as is the case when they are cut over at once—the wood seldom or never ripens, but is weak, and apt to be nipped by the first frost of winter; but when the plants are allowed to have their own natural way for the first season after being planted, and when the stem is allowed to remain and push out a few leaves in order to elaborate any sap drawn up by the roots, these roots become during this period properly and firmly settled in the earth, and are rendered strong and vigorous for being called into action the year following. Hence it is that young trees, cut down the year after being planted, always make more vigorous and stronger shoots in that one season, than trees of the same character cut down when planted, and having two years' growth upon them.

In conclusion, this system ought always to be practised with oak, or indeed with any other hardwood plants, when planted out in a high district, and after being removed from a sheltered nursery; but in no other case is it necessary.

996. The third system of rearing the oak when in its young state, as formerly mentioned, is that of planting the young trees in pits, as is usually done, and afterwards allowing each to come away in its own natural way.

This is the system practised in all moderately sheltered districts for the planting of oaks, as well as all other sorts of young trees, and need not be enlarged upon here. I may mention, however, that in all moderately sheltered districts, young hardwood trees of any sort receive very little check from being transplanted, if they are not above four feet high, and if the soil is one adapted for the growth of the trees planted, and the work carefully and properly done; but if the soil is not of first-rate quality, and if the situation is one much exposed, the trees always receive a violent check, and, consequently, the bark upon the young trees becomes hidebound, and will not carry on its natural functions; but the roots being as healthy as formerly, they, when the old tops are gone, send up young shoots to supply the place of the former, which, as they grow up, become habituated to the climate and situation, and consequently form trees adapted to it. Therefore the planter, when he meditates to bring up a plantation of young oaks or other hardwood, must judge for himself as to which of the two last-mentioned systems he should adopt; and that, of course, must be regulated by his grounds being exposed or sheltered.

997. Different opinions continue to prevail among foresters as to the distance at which oak trees should be planted at the offset, where it is intended to rear up an oak forest. There is no doubt that a difference of opinion will still continue to prevail, according to the views of the proprietor and his forester conjointly; but this does not form a definite answer to the question which has often been put to myself by proprietors—namely, At what distance ought oak trees to be planted with the view of realising the greatest possible profit from the land in the shortest possible time after planting?

This question cannot be answered to all proprietors alike; for in one neighbourhood young oak trees are of considerable value, and in another of comparatively little; in one neighbourhood young larch firs are of more value than young oaks as thinnings, while in others the reverse holds good.

998. In the rearing of oak plantations in exposed parts of the country, where these do not grow rapidly, it is absolutely necessary, for the protection of the young oaks, to have a considerable quantity of larch or pine among them, and that, too, till they are considerably advanced; while in more sheltered districts, where there is little doubt of the oaks growing rapidly, fewer nurses are required. In the laying down of oak plantations, I am in the habit of taking all the above points into consideration; and from having had experience as to the growing of oaks in almost all possible situations, I find that, in order to grow the oak to advantage, it is necessary that every forester should do the same, and by no means go to work according to one set of distances. It is in this way that these differences of opinion relative to distance have arisen; for every experienced forester finds that one system of going to work will not answer all parts, and, judging for himself, he acts accordingly; while, on the other hand, the man without experience advises to plant in all cases according to one set of distances, and the natural consequence is, that a failure is as likely to be the result as a crop. Having premised the above, the determination of the question relative to distance will now be more easily understood, and I shall answer it according to my own method of practice in different situations.

999. When a proprietor meditates planting a part of his grounds in the form of an oak forest, without mixture of any other sort of hardwood, let

him first ascertain if young oaks, when cut down in the process of thinning, will sell to advantage in his neighbourhood, and if they will pay him better than any other sort of wood of the same age. We shall suppose that young oaks, of the size generally termed spoke-wood—that is, trees from five to eight inches diameter, suitable for making the spokes of wheels, sell well; therefore, in such a case, I would advise him to plant the young oak trees at seven feet apart, and make up the ground with larch to three and a half feet between them. By the time that the larch are all taken out and the oaks properly brought into shape, they will be very valuable for spoke-wood, independent of the bark. For coach and cart spokes, I am in the habit of getting, for the former twenty-two shillings, and for the latter thirty shillings, per hundred; this giving nearly two shillings and sixpence per cubic foot of the cut wood, which is nearly double the price that could be received for larch wood of the same age.

1000. Again, if on full consideration it is found that oak in the young state above referred to—that is, from twenty to twenty-five years of age—will not sell well in the neighbourhood, while larch as thinnings will be much more valuable, then plant fewer oaks per acre—say at ten or twelve feet apart, and make up with larch to the proper distance. In this way, by the time the larches, &c., are all taken out, the oaks will be of a pretty large size, and fit for many valuable purposes before the cutting of any of them is found necessary.

1001. Again, where it is found practicable to have an oak forest in an exposed part of the country, it will be necessary to plant a good many larch or pine among them for the sake of producing shelter through the whole plantation, until the oaks have arrived at a good size; and in a case of this nature, from ten to twelve feet is quite enough for the distance between the hardwood plants, making up with nurses in the former instance to three and a half feet over all; and in the latter, that is twelve feet apart, to four feet over all. In the same plantation I very frequently plant at both of the distances above mentioned—that is, in exposed parts of an enclosure I plant the oaks at ten feet, and make up between them to three and a half feet over all; and in more sheltered parts of the same plantation I plant the oaks at twelve feet, and make up with larch to four feet; and when the situation is decidedly a sheltered and low-lying one, we plant the oaks at fifteen feet apart, and make up with nurses to five feet over all.

The above, which is my own system of going to work as regards distance, will, I think, form an answer to the question formerly stated; and it now remains for me to enter a little into the practice of rearing up such a plantation as I have pointed out above.

1002. Suppose that a tract of ground has been planted with oak at ten feet apart, and the intermediate spaces made up with nurses to such a closeness as to leave the whole plants over the ground at three and a half feet distance, the oak trees will, when the plantation is about eight years old, require to be carefully looked over, and pruned in all cases where found necessary, but not severely—for the oak, at no stage of its growth, agrees with much pruning; the wood is of a hard cross nature, and any severe wound made by the knife is not easily healed, even although the plant is young; therefore, pruning should be sparingly practised upon them. All that is necessary at the stage above mentioned, is to prune away one top in all cases where two exist; or where more than two tops appear upon one individual tree, to choose the best, and prune away all the others—to lop off a part of any strong branch that may have the appearance of gaining undue strength upon the regular proportions of the tree, and to clear away any small spray shoots from the lower part, so as to form a clear stem or bole. If this pruning is properly done when the trees are about eight or ten years old, when the wood is in its softest state, no damage will be done; and if the work is properly done at this stage, little or no pruning will ever be afterwards required if thinning be rightly attended to, and neither underdone nor overdone.

1003. The oak not being a rapid-growing tree at any stage of its growth, as compared with many other sorts of hardwoods, the young plants will not, at eight or ten years' standing in a plantation, have attained a large size, probably not above six or eight feet high; but if the nurses which were planted among them for the purpose of giving shelter have thriven well, the oaks will be deriving benefit from their shelter, and progressing rapidly. In fact, young oaks never do come away well until the nurses rise up around and afford them shelter, more especially if the situation in which they are planted be an exposed one, or the soil naturally of a cold bottom. As an instance of the great advantage gained by planting nurses among young oaks, in order to shelter them in their young and tender state, and to bring them away as rapidly as possible, I may mention a case which I witnessed myself in one situation where I acted as assistant forester. There we had about twenty acres of rather stiffish clay-ground converted into a plantation, situated upon what was considered rather a level and sheltered part of the country, although there was no other plantation near it. The ground was fenced by a young hedge all round, protected by a three-barred paling; and as the proprietor wished the plantation to be one of oak, without any admixture of other trees, the ground was planted entirely with oak plants at three feet apart, and without any nurses whatever. The oaks thus planted remained in a dormant state for three years after they were planted: not only did they make no young shoots whatever, but, on the contrary, fully one-third of the plants died out. On seeing this state of things, the forester thought that the whole would turn out a failure upon his hand—set us to work, and had fifteen hundred Scots pine plants planted to the acre, mixing them regularly among the oaks. In two years after this planting of the Scots pines, or five years from the time that the oaks were planted, the former began to make considerable shoots, so as to give a little shelter over the surface of the ground. The oaks now began to throw up healthy shoots from the tops of their roots, or rather at that part where the roots are thrown out from the stem; and in many instances where it was thought that the young plants were dead, they sent up excellent young shoots as soon as shelter was produced. In fact, after this period, the whole plantation throve remarkably well, and the oaks kept pace with the pines during all the time they stood among them; but in a few years they were mostly cut down in order to give the oaks room as they advanced.

From this example I would draw the attention of the planter to the great necessity in all cases of planting either larch or pine among oaks in order to nurse them up while in their young and tender state, the former being thinned out by degrees as the oaks advance in strength.

1004. Having pruned the young trees in the plantation of oaks in the manner formerly described, and that two years previous to any thinning of the nurses from among them being required, the next step in the rearing of such a plantation is to thin away any of the nurses as soon as they seem to encroach upon the oak plants. This thinning, in the rearing up of oak plantations, must at all times be more severe than when thinning away nurses from among the common kinds of hardwood. And, indeed, this particular forms the only difference worth mentioning between the cultivation of the oak and the cultivation of hardwood in general; that is, the oak trees, after they are once properly established in the ground, and brought into proper shape by a judicious pruning, must, through the whole course of their culture afterwards, have more room and air than any other species of hardwood trees. The reason of this difference as regards the cultivation of the oak is this:—The oak is a valuable tree, both on account of its wood and bark: the wood is more valuable when grown of proportionable diameter than when of great length, and it is also of more durable quality when freely exposed to the air than when drawn up weakly and to a great height: thence arises the necessity of giving the trees free circulation of air in order to have valuable wood. The oak is also valuable on account of its bark, as I have already mentioned. Now, in order to produce bark, a tree must have extent of wood, whether that be in the form of trunk or branches.

I have seen an acre of oak trees, one hundred years old, cut down and sold for the sake of both wood and bark, which had been cultivated upon the principle of drawing up the trees tall, and without branches; and according to my note-book, which contains an account of the transaction of the sale, that acre of ground, which contained two hundred trees, sold for £360. On the other hand, upon a neighbouring estate, I attended a sale of oak trees only ninety years old, and which had been cultivated on the principle of giving free air and room to the trees as they advanced; and upon one acre of ground, which contained a part of those trees sold, I counted one hundred and four trees, which brought altogether £868;* making the oak trees, which were cultivated upon the principle which I have recommended—namely, that of giving free air and room—nearly three times the value of those which were drawn up weakly. When oak trees have free room for expanding themselves, the lower branches form into bends for ship-building, which is a valuable object. The trees also, being more branchy in themselves, possess a greater surface for the production of bark; and the bark itself, having free air, becomes thick and heavy upon the tree. It is perhaps not generally known that oak bark produced upon trees having free air about them, weighs almost double that of an equal surface taken from a tree confined and not having air; and, at the same time, bark of such weight is always more valuable, because containing a greater proportion of tanning matter.

1005. What I have here said relative to the cultivation of the oak, I regard as sufficient to convince any proprietor of the necessity of keeping his oak forest thinner of trees than any other of his woods. I need only add, in conclusion, that in every other respect oak plantations are to be managed upon the same principles as other hardwood ones. Oak trees are never reckoned of full age till they have attained one hundred years; therefore, after a plantation of oaks has received its final thinning, it should be allowed to stand until that age before cutting down.

SECTION VI.—SYSTEM OF THINNING AND REARING UP OF MIXED HARDWOOD PLANTATIONS.

1006. The rearing up of hardwood plantations to anything approaching natural perfection, requires much more attention and practical knowledge from the manager than pine, larch, or fir woods do.

In a pine, fir, or larch plantation, the trees are alike of an upright habit of growth, from which circumstance they are very easily regulated and kept

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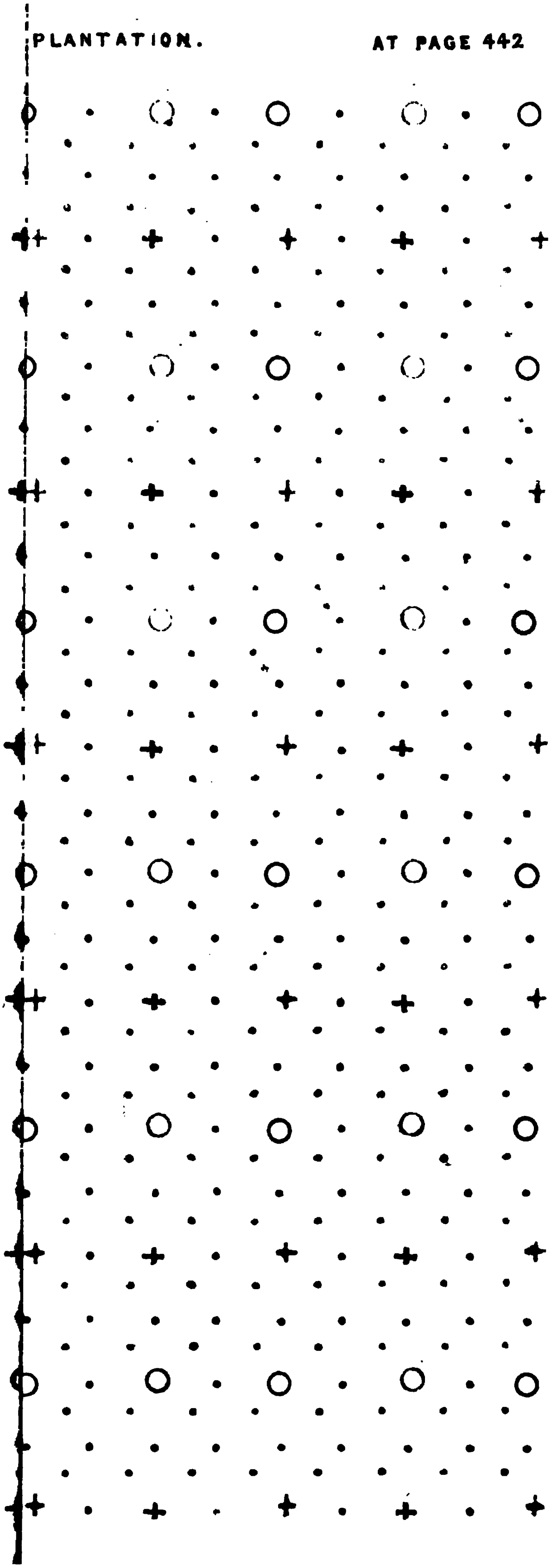
* This was in the year 1820, when oak wood and bark were both selling very high; and the soil being very favourable, it was an extreme case of the value of oak.

PLANTATION. AT PAGE 442



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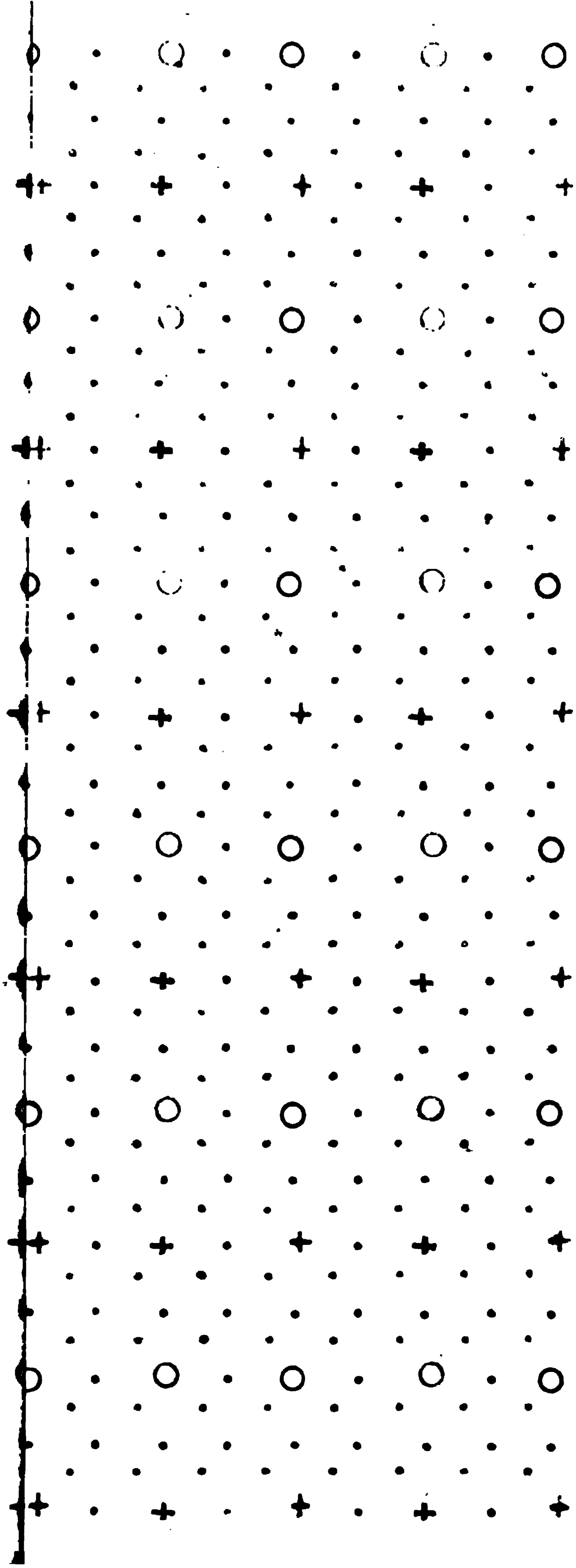


in proper place and order; but in a plantation consisting of many different kinds of hardwood, all growing in a mixed state—some, as the elm, inclining to grow much to horizontal branches, and others, as the ash, tending to an upright growth—much attention is necessary for the first thirty years, in order to keep the rambling sorts within due bounds, and from overtopping and injuring their neighbours which may be less hardy in their young state. And as it is in the young state that hardwood plantations may be made to do well or otherwise, according as they may be attended to, it is a matter of the first importance in good forestry, that the manager be well acquainted with the circumstances which retard the progress of young trees, as well as those which are known to be favourable to their healthy development. Being well aware, from past experience, of the extensive damage which is done to young hardwood plantations in consequence of their being neglected in their young state, I shall here lay down at some length the method which ought to be pursued in order to have healthy and valuable hardwood trees—dwelling more particularly upon the system which ought to be adopted in rearing, till the trees attain thirty years of age; after which time, if they have been properly attended to, little care is required as regards trees individually, except to give them room as they advance in size.

1007. Let the accompanying diagram represent a piece of ground which has been planted with different sorts of young hardwood trees, at ten feet apart, the ground being made up between them with larch and pine, to act as nurses, so that the young trees stand over all at three and a half feet from each other.

In the diagram the different sorts of trees are represented by marks differing either in colour or in character, thus:—

Oak trees, planted at twenty feet apart, are represented by a red circle.
Ash trees, planted at twenty feet, by a black circle.
Elm trees, planted at twenty feet, by a red cross.
Sycamore trees, planted at twenty feet, by a black cross.
Larch nurses, planted at three and a half feet from hardwood, by a red point.
Scots pine nurses, planted at five feet from hardwood, by a black point.

1008. Upon examining the diagram, it will be found that each sort of hardwood tree is planted in such a manner that each tree of the same sort is exactly twenty feet from the next of its own species. This is an important point to attend to in the planting of mixed hardwood plantations; for it may ultimately be found necessary to cut out the whole of one sort; and in this case, the others which were left would stand at equal distances after these had been removed. The ash and sycamore are planted within ten feet of the oaks, while the elm is kept fourteen feet off them. This is another point of much importance to attend to in the planting of mixed hardwood plantations. For example, supposing that the oaks, which are planted at twenty feet apart, are intended to remain as the only ultimate crop, then the ash and sycamore, which are of an upright habit of growth in a close wood, could grow for a longer time close upon the oaks than the elm could safely do, which is of a spreading habit; therefore the elm, at fourteen feet distance from the oak, would be as close upon the oaks at thirty years' standing, as the ash and sycamore at the same time. The larches are planted three and a half feet from the hardwood plants. The reason of this is, that the larch, from its light and airy habit of growth, is found not to hurt the hardwood plants so much as the Scots pines would do at the same age; for which reason, also, the Scots pines are for the most part planted five feet from the hardwood plants. Besides, the larches, being planted next the hardwood, are likely to be taken out first in the way of thinnings; and in this case they are of far greater value when cut at an early stage than the Scots pines. The four larches, which are planted next each hardwood plant, can be all taken away, in the way of thinning, a considerable time before it is found necessary to cut a Scots pine; and by this arrangement the Scots pines can be allowed to stand and grow till they become of some value:

1009. We shall now suppose that a pretty large tract of ground has been planted with young forest trees exactly in the manner represented in the diagram. We shall further suppose that the ground so planted has been properly drained and rendered congenial for the future welfare of the plants; for, let me again observe that much of their future success depends upon this. A very indifferent soil, if well dried, will produce much better timber than a good soil having a superfluity of water in it; hence the importance of a thorough clearing of the ground from all superfluous water before planting forest trees upon it. Presuming that the ground has been well dried, by means of open drains put on at consistent distances, and that the young trees have been properly planted according to directions, as formerly given in this book, the next question which naturally occurs is, At what stage of the growth of such a young plantation should thinning commence? This is a question which has given rise to a great deal of useless discussion among those who have the management of plantations; all this arising from not taking into account the effect of altitude upon the growth of young trees; and not only the effect of altitude, but even the effect of soil and aspect, and in fact many other local circumstances which cannot always be accounted for. For example, in districts of the country pretty far inland, and upon estates of a generally level nature, four hundred feet above the level of the sea, I have seen foresters thinning their young plantations for the first time at eight years old from the time of planting; while, on the other hand, upon the west coast of Britain, upon estates within a few miles of the sea, and at four hundred feet above its level, I have seen young plantations, under excellent management, not ready for thinning when they were ten years old, and that although the young trees were planted at the same distances from one another in both cases. Now, this at once points out that, independent of altitude, other local circumstances must be taken into consideration; as, for instance, if the ground planted be upon a level part of the country, the trees will grow quicker than they could do in a hilly district, even supposing the altitudes of both to be the same; while, again, trees grow much faster in a glen or hollow than upon a common level piece of ground, and in a large plantation than in a small one. And with regard to soil, when it is of a light or sandy nature, young trees grow very quickly upon it for a few years, and soon arrive at maturity; while, at the same altitude, upon a heavy or clay soil, trees will be longer in getting away, but will ultimately be far superior to those planted upon the light soil. Every intelligent forester, who has had the management of plantations upon an estate of considerable extent and of a varied surface, will have had occasion to remark the great difference that occurs in the growth of plantations, even within the bounds of one estate; and that according as the plantation may be situated upon a sudden rising height, upon flat level ground, in a hollow or glen, upon sandy or light soil, or upon heavy clay soil; and I must say also, according to shelter received from surrounding plantations, &c. It will then at once appear evident that, to give anything like a rule for the time at which a young plantation should be thinned at first, is a thing, properly speaking, impossible, as I have learned from practical experience. There are, indeed, men, whom we may properly term theorists, who pretend to lay down exact rules for the thinning of young plantations at any given stage, and who even state the exact size that a tree should be at a given age, without having any regard to local circumstances affecting the growth of trees; all which arises from the want of experience, and from ignorance upon the subject of growing trees: for even a person unacquainted with forest matters will at once admit that, in some sheltered situations, trees will be fit for a given purpose at twenty years from the time of planting, while others of the same age, planted upon an exposed part, will not be nearly so large.

1010. Upon the estate of Arniston the plantations are situated upon land varying from four hundred to thirteen hundred feet above the level of the sea. A considerable portion of these are growing in glens or hollows—a portion on level ground, about the home domains—and another portion growing on a high moorland part of the estate. Having such a varied surface for the growing of plantations upon this estate, I shall here, for the guidance of those who may not have similar opportunities, lay down the different ages at which I have thinned plantations on that estate, mentioning at the same time the nature of the soil, and the altitude of each.

1011. *First,* In a hollow or glen, four hundred feet above the level of the sea, planted with oaks at twelve feet distances, and made up with larches to four feet over all, I have found it necessary to thin out the latter at seven years from the time of planting. The soil in this instance was a light sandy loam, with, in many places, rocky projecting points, with very little soil.

1012. *Second,* Upon a level part of the estate, about seventy feet higher than the glen above mentioned, is a mixed plantation of the same kind as the above, and planted at the same distances, which I found necessary to thin at eight years from the time of planting; the soil in this instance being what may be termed a clay loam, and having been, before being planted, under agricultural crops.

1013. *Third,* Another young plantation, consisting of oaks planted at eight feet distance, and made up with Scots pines and spruce firs to four feet over all, was thinned when of nine years' standing. The height of this plantation was five hundred feet above the level of the sea, situated on a level part of the estate, the soil being rather a stiffish clay.

1014. *Fourth,* Upon the same level with the last-mentioned plantation, but in a hollow, I thinned larches from among the hardwood for the first time at eight years old. The soil here was much the same as that last stated; but the situation being in a hollow, the young trees came more rapidly forward from being sheltered.

1015. *Fifth,* A young plantation, six hundred feet above the level of the sea, consisting of oaks ten feet apart, made up with larch and spruce firs, I thinned for the first time when of ten years' standing. The soil in this instance was very variable; in some parts approaching to clay; in others, sandy loam; in others, gravelly; and in others, mossy: consequently, from the great variety of soils contained in this plantation, it was not generally alike at the same time ready for being thinned. On the dry sandy soil I found the larches had grown very rapidly, while on the more clayey parts they had not come nearly so rapidly away. On the clayey parts, and particularly where the moss and clay approached each other, I found the spruce firs had far outstripped the larches in the rapidity of their growth.

1016. *Sixth,* In a pretty large glen, situated six hundred feet above the level of the sea, is another plantation of eight years' standing, which I found necessary to have thinned at that stage. The trees consist of oaks planted at eight feet apart, and made up with larch and spruce firs to four feet. The soil is a sandy loam, in many places sand very much predominating.

1017. *Seventh,* A number of plantations, situated seven hundred and fifty feet above the level of the sea, and upon a rather exposed northern aspect, I found not requiring to be thinned for the first time before they were twelve years old. The crop of trees in these is mixed hardwood, at ten feet apart, made up with larch, Scots pine and spruce firs, to three and a half feet; and the soil in general is a sharp sandy loam, and in many places gravel. Generally speaking, all the plantations upon the estate of Arniston, which are situated between seven hundred and fifty and nine hundred feet above the level of the sea, I have not found necessary to thin, although the trees are planted at three and a half feet apart, before they are twelve years old; excepting, indeed, hollow parts, where there is natural shelter produced. In such hollows, even at eight hundred feet of altitude, I have found it necessary to thin at nine and ten years of age.

1018. *Eighth,* At one thousand feet above the level of the sea, where the natural surface soil is of that description known by the name of *sandy moss*, producing short bushy heath, I have never found it necessary to thin for the first time, even when the trees were planted at three feet apart, till they were fourteen years old: at the same altitude, that is, one thousand feet, where the soil is of a loamy nature, and adapted for the growth of hardwood, I have found it necessary to thin larch from the hardwood at from twelve to thirteen years.

1019. *Ninth,* In pine and larch plantations, planted upon goodish loamy soil, at twelve hundred feet above the level of the sea, having a northern aspect, I have not found it necessary to thin trees planted at three feet apart before they were fourteen and sixteen years old; excepting, indeed, in any hollow glen, where, of course, from the effects of natural shelter, two or three years may be gained.

1020. Now, from the above statement, it will appear evident that altitude has much to do in the bringing of trees to a given size within a given time. Those, therefore, who say that every plantation should be thinned at such and such a time, only expose their own want of knowledge in the matter, and ought not to be trusted as guides in forest operations.

1021. We shall now suppose that we have in hand a plantation of fifty acres in extent, which has been planted with a mixture of hardwood, pine, and larch, exactly in the proportions pointed out in the diagram. This plantation we shall suppose to be upon a moderately exposed situation, say eight hundred feet above the level of the sea, and pretty far inland, having a soil of moderate capabilities. Such a plantation will, in all probability, be ready for the first course of thinning when from ten to twelve years old; but before commencing to thin out any of the larches, it will be necessary, in the first place, to have an eye to the state of the hardwood plants, which of course are intended as the principal and ultimate crop upon the ground.

1022. In the rearing of plantations generally, and more especially in the case of those in which it is intended to rear up a supply of various kinds of hardwood for general usefulness, independent of a particular sort which is to remain as an ultimate crop upon the ground, the forester requires to watch them continually, in order to keep them in a constantly healthy growing state. The trees, after they have got properly established in the ground, must not be allowed to become so crowded together as to impede the free action of air among them; neither must they at any time be thinned so severely as materially to cool down the usual temperature of the whole as a plantation, as is too often done. A forester, therefore, in order to raise plantations profitably, should have the state of every plantation under his charge continually in his eye; for unless this be the case, matters will without doubt go wrong. The forester will then, in the case of such a young plantation as we are now discussing, observe at what time the points of the side branches of the larches begin to touch those of the hardwood plants next them; and as soon as this ensues in the plantation generally, it is time to give the hardwood plants a prune, which should in all cases be done before any thinning of the nurses takes place. In the case of such a plantation as is now under consideration, this pruning will, in all probability, have to be made in the eighth or ninth year, independently of other prunings they may have received when younger.

1023. In pruning the young hardwood trees at this stage, have all strong branches that may have the appearance of gaining strength upon the top shoots of each tree cut clean away from the bole. At this early stage, and while the plants are in a young and sapling state, they are much improved by a judicious lopping off of all large branches; for immediately after such treatment, the trees push upward in a vigorous healthy manner, making double the progress that others do under like circumstances, which have not been pruned of their superfluous side branches. Having thus gone over all the hardwood plants, and pruned them in the manner stated, have any of the side branches of the larch plants that may be likely to interfere with the hardwood soon, cut away with a hedge-knife, taking care, however, to do so carefully: that is, do not cut the branches close to the stem, but only about half-way in upon themselves; for, were these branches to be cut close in upon the surface of the stem, the young larch trees would in all probability lose much of their sap at the wounded parts and consequently the health of the trees would be much impaired. This pruning of the hardwood trees should be done in the months of May and June, and never later than the last week in July. If this be not attended to, the wounded parts will not heal up properly before winter set in. I have frequently had occasion to observe, that young trees which had been pruned in September were much injured at the wounded parts during the frost of the following winter; and the consequence, of course, was, that the trees so dealt with were unhealthy for a considerable time afterwards, while the cause of their unhealthiness was attributed to anything but the truth. One man, with ease, will prune the young hardwood trees, and clear them from any side branches of the nurses, upon an acre of ground, in one day; for at this stage the work is easily performed. Many object to the doing such work, on the ground of its expense; but this is a very great mistake: at the very utmost, two shillings and sixpence an acre may be reckoned upon as the price of such work, which is, comparatively speaking, a mere trifle, considering the advantage derived from it. We have men so trained to the work, that one will prune and relieve the crop on nearly two acres in one day.

1024. Having pruned the young hardwood trees, and relieved them from the points of any of the side branches of the nurses, they will, from having the advantage of shelter all about them, make strong and vigorous shoots, and their side branches will, in the course of two years after this pruning, have nearly met with those of the larch. By that time they will have gained a confirmed healthy growing state, and have completely recovered from the effects of any pruning they may have received; consequently they are then in a fit state for being exposed to free air, as they always are after being thinned for the first time; while, if young hardwood trees be properly attended to in pruning them in the manner and at the stage above stated, they seldom or ever require much pruning afterwards. The great error which prevails among inexperienced foresters, at the present time, in the management of young hardwood plantations, is, that they both thin and prune at the same time. Now, no system of management can be more injurious to the health of any plantation than this; for, when a few branches are lopped off a young tree, it will often die when exposed suddenly to a temperature below that which it formerly used to exist in; and this lowering of temperature invariably ensues when thinning and pruning are executed at the same time. But if, when a young tree is pruned, the temperature be increased rather than otherwise, the tree is immediately improved by the operation, and decidedly attains a more vigorous constitution than it formerly possessed; and this, again, is exactly the case when pruning is done in the early part of summer, and a considerable time previous to thinning. We may herein see at once the evil of both pruning and thinning at the same time, and the great propriety of pruning trees a considerable time before exposing them suddenly by thinning.

1025. I said above, that, in the course of two years from the time that the hardwood received the pruning, their side branches would be about to meet with those of the larches. This is a stage in the culture of young hardwood trees to be closely observed by the intelligent forester; for if the branches of the nurses are allowed to encroach upon the hardwood, they will very soon hurt them by lashing and crushing them down; for let it be kept in mind, that the larch grows much more rapidly than the hardwood does; and the former are not planted with the view of doing injury to the hardwood plants, but, on the contrary, to nurse them up and protect them. Again, on the other hand, there is a possibility of injuring the hardwood plants by taking the nurses too early away from them; and this also ought to be avoided as much as keeping them too close. Every forester of extensive experience will have observed that hardwood trees, when at the stage to which we are now adverting, if kept too far from their nurses, are extremely apt to become of a branchy coarse habit, and not inclined to grow upwards so much as to grow to strong side branches. This is an evil of very great magnitude, and ought in all cases to be guarded against where clean healthy timber is the object. There is, therefore, a medium course to be followed; and the question is, by what feature can an inexperienced person decide upon the proper time that he should begin to thin away nurses from the young hardwood? The right answer is not so easily given as many would suppose. To the eye of an experienced forester the matter is indeed simple, but to convey his experience upon this point to the mind of an inexperienced stranger, is not such a simple matter.

The best rule for guidance in this matter is, to go carefully through among the trees, and mark particularly the state of the hardwood plants; specially observing if the branches of the larches are here and there lying upon and interfering with those of the hardwood; and if this be the case, thinning should be commenced. Having, then, decided that thinning is necessary, the first step in the work is to have the nurses marked which it is considered should be taken out; and in order to do this properly, considerable practical judgment is required. All theoretical men, who have had little practical experience to form their judgment with regard to thinning young plantations, maintain that, at a certain age of a plantation, a certain number of trees ought to be cut away from each hardwood plant; thus reducing practical forestry to a few rules of practical geometry. This sounds all very well in the ears of other inexperienced men, but when reduced into practice, it proves an utter absurdity. Plants are, like animals, often found to die suddenly, and that, too, without our being able to give a reason for it; besides, nothing is more true than that all trees of the wood do not grow alike; and seeing this, we must, in the case of thinning, judge for ourselves, and, from practical observation, choose which should stand and which come out.

1026. In practical forestry the operator will very generally find that of the four larches planted about each hardwood tree (see Diagram), one or two may be of a pretty large size, and others of a smaller; one or two may be lying too much upon the hardwood plant next them, and others be found not doing it harm, but on the contrary sheltering it; and these may therefore be very properly left for a time. This at once points out the harm that would be done to plantations were we to thin them according to any theoretical rules. On this point also the theorist says, "at the first thinning, cut away all the four larches that stand next the hardwood in each case." Now, I have already said that when young hardwood trees are allowed to have too much space in the plantation, they naturally incline to spread their side branches, and do not grow so tall as they ought to do in order to make clean valuable timber. In such a case as this, much pruning would be necessary in order to keep the trees in shape and put them into balance; and this severe pruning is always injurious; and were we to cut away all the four larches at once, this would be the precise state of the hardwood trees. A single glance at the diagram will show the tendency of such treatment. The four larches stand at three and a half feet distance from each hardwood. Now, were these taken away at once, what a severe check would the hardwood receive! Before the thinning took place these nurses were close upon, and even touching, the branches of the hardwood plant; whereas, by their removal, there would be a space of five feet between the hardwood plant and each of the Scots pines on the one hand, and another space of seven feet between them on the other. This would not be nursing up timber upon right principles, but the very way to retard its growth.

I would not have adverted so much to this, were I not aware that there is a class of men who term themselves foresters, whose views have a tendency to deceive proprietors by such statements as I have given above; they never having had any practical experience of their own even to prove the evil of the opinions which they hold in forest matters. I am, therefore, anxious to put proprietors upon their guard as to how far they give heed to them.

1027. Having, I think, pointed out the evil which would arise from going to work in forestry according to theoretical rules, it is evident that practical experience is the only schoolmaster for the person who is to mark the trees which should be taken out of a plantation at any period of its growth; and seeing that no invariable rule can be laid down as a guide, the operator may safely go to work conformably with the following directions:—

He will first provide himself with what is termed a *hand-bill*, with which to mark the trees which are to be taken out; and with this implement in his hand, he will take his station on the most sheltered side of the plantation to be thinned. My reason for beginning upon this side is, that all trees have fewer branches upon what is termed the *storm side*, than they have upon the other; consequently, the nurses growing upon the storm side of the hardwood plants will have their inner branches, or those upon their sheltered sides, more abundant, and more lying upon the hardwood, than those which grow upon the sheltered side of the latter. Now, the operator, from keeping this in view, and beginning upon the sheltered side of the plantation, sees much more readily, as he advances, the branches of the nurses which grow upon their sheltered sides, and can more easily judge of the extent of the injury they may be doing to the hardwood trees.

Being thus stationed with a hand-bill for the purpose of marking, he will walk up to the first hardwood plant at the point where he intends to commence; and having done so, he will examine which of all the larch trees about it has its branches lying most upon it, and which will, without doubt, be the one that stands most directly between the hardwood plant and the storm point. Having decided upon this, and marked it with the bill, by simply breaking off a few of the branches, or by taking a *slice* of the bark from it, he will have a man or two following him, each with an axe, whose duty will be to cut each tree as it is marked. In the cutting of it, the operator will, with his axe, prune a few of the lower branches from it, in order that he may the more readily get his implement to the root of the young tree; and this being done, he will cut it as low as possible, beating away any of the grass with the head or heel of the axe, if that be any obstruction to his getting it cut sufficiently low. The tree, as soon as it is cut, should be hauled out by a boy present for the purpose, and laid down upon the nearest road in the plantation, where another boy should be stationed for the purpose of taking off all the branches with a hand-bill. Small trees of this description should be pruned out to the very points, and put in bundles or small lots, for the convenience of removal.

1028. We shall now suppose that one larch has been marked, cut, and carried out, the one which had been hanging most upon the hardwood plant

Now, from this one tree having been removed, the person whose duty it is to mark the trees will see more clearly how the hardwood trees may be affected by the removal of the one. He will after this be more able to judge as to which of the others should be taken next; and if the branches of any of the other three larches, which are yet supposed to be growing about the hardwood plant in question, are found in any way to hang upon, and are likely ere long to injure it, let it be marked and cut away also.

1029. At this early stage of the growth of such a plantation as we are now speaking of, it will very seldom be found necessary to cut away more than two nurses from each hardwood plant, and in many instances even one may be enough to take away at once, with the view of retaining a regular proportion of shelter throughout the plantation, as well as of doing justice to each hardwood tree. Therefore, at this stage, I would advise that where any of the larches are not encroaching upon the branches of the hardwood plants, nor likely to do so for the next two years, they should be left till the next period of thinning, which, according to the scheme laid down in a former section, will take place three years afterwards. By such a cautious method of procedure the trees will succeed much better, and not receive any sensible check.

1030. In the same manner as has already been pointed out for the relieving of the first hardwood tree, do to the whole in the plantation, paying no respect to the nurses themselves, but having the attention constantly directed to the relieving of each and every one of the hardwood. The nurses, in this instance, are merely planted with the view of rearing up the hardwood plants; and when they begin to hurt them by their pressing too close upon them, they must, of course, be removed. The person who marks the trees need not wait in all cases till he sees the one which he marked cut down; this would be a tedious business: but if he has never marked any trees before, as I am at present assuming he has not, it is but proper that he should begin cautiously, and see the effects of his judgment before he proceed too far. This he may properly continue to do for a day or two; by which time, if he is an intelligent and observant person, he will be able to go on marking before the cutters. He may now and then take a walk back upon the ground he has gone over, and see the effects of his work; and if anything presents itself that he could improve upon, such as marking a few extra trees which may appear to be too close upon the hardwood, this will have the effect of improving his judgment in the work he has on hand, and make him more attentive in future. In marking the trees, let it be done invariably upon one side; for if this be not attended to, the person who comes behind to cut them will lose much valuable time in looking for the marks; while, if the trees are all marked upon one side, he will have no difficulty in finding them out.

1031. After the trees have been all carried out and pruned of their branches, as has been already directed, they should be removed from off the roads by means of a horse and cart, and stored in any convenient part until sold. If they can be sold beforehand, so much the better, as by this means considerable trouble will be saved in their not having to be carted and stored past at home. The size of these larches, at about ten years old, will, in a moderately exposed situation, eight hundred feet above the level of the sea, be from eight to ten feet in length, and from an inch and a half to two inches in diameter at the middle. They should, on an average, be worth 1½d. each, and in most districts sell very readily for various kinds of fencing purposes, handles for agricultural implements, poles for training flowers upon, &c. &c. We are in the habit of cutting many thousands of these every year, and find that they pay us well, there being a great demand for them: this year (1859) we have not been able to supply the demand for fencing purposes. They are sold at 3d., 2½d., 2d., and 1½d., according to size; this showing that small larch thinnings, apart from their use in nursing up the hardwood trees, are, when cut down, a valuable commodity to the proprietor, and very soon come in to pay him the rent of his land. I am the more desirous to draw attention to this, from being aware that some think that young thinnings do not pay the proprietor his expense of planting and rearing them up. This is, of course, a decided error, and only indicates bad management on the part of those who have found it so.

1032. In three years from the time that the plantation had received its first thinning, it will again be necessary to look over the hardwood plants, and take away from them all the larches that seem to approach and hurt them. At this second thinning it is very possible that all the latter will require to be taken out; for, if we now suppose the plantation to be of thirteen or fourteen years' standing, the Scots pines which stand within five feet of the hardwood (see Diagram) will be strong and healthy young trees, and will, from their massy foliage, prove shelter enough to the hardwood. This, however, must not be taken as a rule; for even at this stage, upon any prominent high part of the plantation, it is very possible that the hardwood trees may not have advanced so very rapidly as might be imagined. In such cases, therefore, it will be proper to leave a few of the larches till the next course of thinning, in order to shelter the hardwood and bring them into shape; for, if they be exposed at this stage, they will not be easily got into shape afterwards. But in all moderately level parts of the plantation, and more particularly in any hollow, all the larches may at this time be, without hesitation, taken out; while, by the time the plantation has arrived at seventeen years of age, the larches may all be dispensed with, leaving the nearest trees to the hardwood—namely, the Scots pines—at five feet distance from them. (See Diagram.) In taking out all the larches, have the work done exactly as I have already described for the first course of thinning; except that, when they are come of a pretty large size, they will require to be pruned of their branches on the spot where they fall, and the trees carried out to the roads, while the branches can be gathered up and burned afterwards.

1033. In practical forestry it is found that the whole number of the trees that may have been originally planted upon the ground, cannot be accounted for in the course of thinning and training up; and this observation I make here, in order that the inexperienced may not have too sanguine hopes as to the results of after profit. Having now had the management of thinning a vast extent of woodlands at all possible ages, and having kept accurate notes of the results of each as I went on, I have found that, even under very good management, 5 per cent will be found amissing when the season of thinning commences; and even after the trees have arrived at the stage of growth we are now speaking of, I have frequently found many go back. The reason of such deficiencies occurring is, that while the plants are in a very young state—say during the time that they are under five years of age in the plantation—they are liable to be attacked by vermin of every description, such as hares, rabbits, mice, squirrels, moorfowls, &c. &c. Hares and rabbits destroy young trees, both nurses and hardwood, by gnawing the bark upon the stems and branches. I have often seen young trees, three quarters of an inch in diameter, completely cut through by such vermin; consequently such trees were rendered useless if of the pine and fir tribes; but, of course, hardwood trees, although gnawed over, would again come away from the bottom part. Mice and squirrels injure young trees by eating out the buds. If the winter and spring happen to be a severe one, they also peel the bark from young trees wherever they can reach it; and when severe frosts set in, trees so injured very frequently die in consequence of the frost affecting them at the peeled part. Moorfowls are very destructive to young Scots pine plants, by picking out all their principal buds; and from this cause alone I have seen very many young trees killed. It will thus appear evident to the young forester, that he must not be disappointed although he cannot find all the trees which he knew were originally planted upon the ground; and this I am the more particular in mentioning, seeing that there are theoretical *foresters*, or rather men, who say that no tree should go back under good management. We may as well say that no medical practitioner should be called in to see a patient who cannot cure every disease in the human subject, or that no medical man is perfect who cannot cause his patients, every man and woman, to live till they are a hundred years old. Theorists will appear in every branch of science, and in every professional business, and will lay down rules which, in their own estimation, are infallible; but in every profession it is the practical man alone that is to be depended upon as a guide. From my practical experience as a forester, I am led to state that, as a medium, 5 per cent of the trees planted will be found amissing by the time that a plantation is fifteen years old.

1034. At this stage of the growth of the young plantation, the method of training up which I am now endeavouring to explain, it is necessary that the forester should examine if all the hardwood plants are really worthy of being kept as the permanent crop; and in examining this let him be particular, not so much as to the shape of each plant, as to the state of its health. In every case where a hardwood plant does not appear to have made young wood freely for some years past, and is of a stunted habit of growth (and this will sometimes occur), let him cut it away and give place to one of the nearest nurses; this being a larch if possible, as it will ultimately become of more value than a Scots pine would do, provided the soil be suitable. It is also, from its upright habit, better adapted to stand as a permanent tree among hardwood. All the above points having been attended to, it will again be necessary, at seventeen years—that is to say, if the plantation was thinned for the first time when eleven years old—to look over the whole; for at this stage a number of the Scots pines will be encroaching upon the hardwood. These should be taken out, on the same principles as already detailed regarding the thinning out of the larches; the attention not being directed to the taking out of any given number of trees from each of the hardwood, but merely taking out those that are really pressing upon them, or likely to do so within the next period of three years. By going to work regularly once in three years with this course of thinning, by the time that the plantation has arrived at twenty-six years old, every one of the Scots pines which were growing at the distance of five feet from the hardwood will have been removed, thus leaving one Scots pine plant standing in the centre of the square formed by each four of the hardwood plants; consequently at this age the hardwood will be seven feet from the nearest Scots pine in each case. (See Diagram.)

1035. By the time that the plantation has reached twenty-five years old, the hardwood trees will be all of a strong healthy habit, and very probably may average twenty feet in height, with an average diameter, at five feet from the ground, of four and a half inches, having abundance of moderately strong leafy branches upon them for two-thirds of their height. Now, at this stage of the growth of hardwood trees, they ought to give prospect of their future worth. In the state above mentioned, the remainder of the Scots pines should be allowed to stand till the oaks are about thirty years of age, when another thinning should be commenced, by taking the Scots pines away from the oaks. This thinning, too, as well as all the former ones, should be done gradually, and not all at once, as some recommend; and I may say that, in general cases, by the time that the plantation is from thirty-two to thirty-four years old, according to the age at which thinning was commenced, every nurse, excepting, indeed, any that may have been left instead of any bad hardwood, should be removed from among the hardwood, leaving them among themselves at ten feet apart. (See Diagram.)

1036. In any high and exposed point of a plantation, it is wisdom in the forester to have a considerable portion of the nurses left standing. They are more hardy than the hardwood sorts; and, when growing upon an exposed site, such as the outside and towards the storm-point of a wood, they form a protection to more valuable trees in the interior. In the act of thinning such parts, where it is considered necessary to have the nurses left, it must be kept in view to have a portion of the hardwood taken out, and nurses left in their place; as, of course, they could not grow up all together.

1037. As it is, from experience, found that all the hardwood trees do not advance at the same rate, I may remark here, that even at the time that the last of the Scots pines are being taken out, it may be found necessary, in sheltered parts of the plantation, to take out a few of the hardwood also. Of course this will take place in such parts as were first relieved of the Scots pines; for, in sheltered parts, and upon a pretty good soil, the very same circumstances that cause the rapid advance of the nurses will cause a similar advance of the hardwood. This point also must, therefore, be kept in view by the intelligent practical forester; and in taking out a few of the hardwood trees at the stage we are now referring too, he will first carefully note which sort has the appearance of attaining the most valuable development as an ultimate crop upon the ground. In the case now under consideration, we shall suppose that sort to be the oak; consequently, in taking out any of the hardwood trees at the period referred to, care must be had to see that they are given every advantage to. Again, at the same time, care must be taken to see which sort of the hardwood trees is the most unhealthy, and has the least chance to become of a healthy and valuable size. We shall suppose this to be the ash; and being satisfied upon this point, the forester must act accordingly, taking out the ash as the first thinning of the hardwood. By this method more space will be given to others that have the appearance of becoming more valuable upon the ground.

1038. In the cutting down of the Scots pine trees from among the hardwood at the advanced stage of about thirty years, great care must be taken to see that no damage be done to the hardwood by their falling upon them. In order to avoid this, it is only necessary to have the pruning-chisel at hand, and by means of it to take off any heavy branches from the nurses before cutting them down; and when their tops are lightened by this means, an expert woodman will cause them to fall to any given point very exactly, which point must, of course, be that of the greatest opening in the neighbourhood of the tree to be cut down. In carrying out trees that have been cut from a plantation at the stage we are now referring to, the work should be entirely performed by a few men, and no horses should be allowed to draw them out, as is often done, to the great damage of many of the standing trees. This damage is occasioned by the cut trees, while being roughly drawn out along the ground, coming in contact with the stems of the standing ones, and taking the bark off them. At the stage now referred to, therefore, the cut trees should be carried out by the woodmen, either upon their shoulders as they may be able, or by means of handspokes, to the nearest part of the roads.

1039. As the hardwood trees will all be making rapid progress between thirty-two and thirty-six years of the age of the plantation, we shall now suppose that, by the time it has arrived at the latter named period, all the ash trees have been removed for the purpose of giving ample space to the oaks. It will be observed, by looking at the diagram, that the ash trees are situated alternately with the oaks in one line, while the sycamores are situated in like manner with them on the other line of view. Ash trees, at the age we are now referring to—namely, at from thirty-two to thirty-six years old—are in a very fit state for many country purposes, and particularly for handle-wood; and will, if growing in a favourable soil and site, sell at a good price. I am selling ash handle-wood at 2s. 6d. per foot cube; but allowing that, upon an average, only 1s. 6d. can be got for it, then each ash tree, at thirty-five years old, will contain about five feet of wood, and thus make each worth 7s. 6d. Again, by the time that the plantation has attained forty years of age, it will next be necessary to have the greater part of the sycamores taken out, leaving the oaks at about twenty feet apart. It may be necessary to remark here, that in taking out the sycamores it may in many instances be found advisable to leave one near to an oak of a weaker growth, and, at the succeeding course of thinning, it can be decided which should remain as the permanent tree. This matter must be left to the judgment of the forester in charge. But, with the view of illustrating the case now before us, we shall suppose that the sycamores have all been removed, and the oaks left twenty feet apart from each other on the one hand, and fourteen feet from the elms on the other. (See Diagram.)

1040. In the course of five years after—say when the plantation is about forty-five years old—it will be necessary to have the greater part of the elms taken out also. At this stage they will be of good value, and fit for coach naves, trams, and many other valuable purposes, and may be worth, at an average, if at all near a good market for their sale, about 20s. each. In removing the elms, as well as in the case of the sycamores, it may be found necessary to leave a portion, as I already explained relative to the sycamores; for no thinning of the trees should be done suddenly, or to exact rule: in many cases the whole may be required to come away for the sake of the oaks, while in others a few may be required to remain for a time longer. In the present case, we shall suppose that by the time the plantation has attained the age of fifty years, the trees in general will be left standing at about twenty feet apart from each other all over the ground. Hardwood trees, of fifty years old, standing at twenty feet apart, will have ample room to develop themselves in a vigorous healthy manner for six years, and till they are about fifty-six years old, when another course of thinning will in all probability be necessary; and at that stage, if they have succeeded according to expectation, a few trees will probably require to be taken out in order to relieve others of a more vigorous growth. In this case no rule of distances can be given; for the trees will in some instances be very close upon one another, and in others, according to their growth, they may have quite enough of space, and stand freely. In the same manner the plantation may be gone over regularly at periods as occasion may require, till there are left upon the ground about fifty trees per acre; which will in all probability be when they are about eighty years old. They may then most properly be left for a period of other twenty years, which would make them about one hundred years old, at which age they will be suitable for any purpose for which large oak is required.

1041. In all cases where it is considered necessary to take out the roots of large trees in order to convert the land into agricultural fields, the roots should be taken out with the trees at the same time they are taken down. By this means a great advantage is gained, by having the tree as a lever for lifting the roots out of their places; consequently the work can be much cheaper done than if the trees were cut over by the surface, and the root allowed to remain till the trenching of the land took place.

1042. There is also the case of neglected hardwood plantations to be taken into consideration; and, indeed, cases of this nature too often come under the observation of the forester who may have extensive practice. I have often had to deal with plantations consisting of hardwood and coniferous trees, mixed and growing together in the proportions formerly mentioned, which had never been thinned up to the time that I examined them—and they were then thirty years old. The hardwood plants were then about ten feet high, and from two to three inches in diameter; and the coniferous trees, which had grown rapidly, were large massy ones, fully thirty feet high. On consideration, I concluded that no remedy could be used in order to recover the hardwood plants, seeing that they had been so much stunted and crushed down. There was, indeed, one way in which they might have been made to grow to advantage, but it must have been at the expense of the others; but as they were good trees, the operation would have been a decided loss to the proprietor. The only way to have saved them would have been to have cut them all down to the ground, and to have made them all spring from the root afresh; but in order to have given them a proper recovery, one half of the others must have been sacrificed. In several instances where I have had to deal with plantations consisting entirely of hardwood plants, so old and so much drawn up together from the want of thinning, that they had actually become mere poles of thirty feet high, and not more than four inches diameter, I have cut the whole plantation over to the surface of the ground, because thinning was out of the question; and, in such cases, I have had an excellent growth of young trees from the old stocks, which, in ten years after, formed a first-rate plantation of trees, they having been all thinned out to regular distances in due time, and not allowed to rise too thickly again.

1043. In all cases of neglected hardwood plantations, where it may be considered advisable to cut down the trees in order to cause them to send up fresh young shoots to form trees, care should be taken to see that the ground be made perfectly dry by a proper course of draining; for if this point be not attended to, disappointment may possibly be the result.

1044. Wherever hardwood plantations are found to be in a bad state, from having been neglected for a period at or beyond thirty years, there is little hope of their recovery by any course of thinning, however cautiously it may be gone about, unless the trees evidently show symptoms of a sound constitution, which may be the case where the soil is good and dry. Therefore, in all such cases, unless symptoms of health be remarked in the trees, the proper and only way is to cut all down and plant anew; and if the situation be one exposed to the view of the mansion-house or pleasure-grounds, where a complete clearing away of the mismanaged plantation would cause a bad effect, a few of the best and healthiest trees might with propriety be allowed to stand for a time, in order to give effect to the landscape, until the young trees had attained a considerable size.

1045. What I have said above relative to the rearing up of hardwood plantations, is only applicable to them when grown for the sake of their timber; but upon proprietors' estates, hardwood plantations are more generally raised with the view of being ornamental upon the lawns and home parks, than simply for the sake of the value of their timber.

Every proprietor who lays out new grounds in the neighbourhood of his mansion-house, if no plantations exist upon those grounds at the time, will, in accordance with good taste, and with the view of affording shelter, plant extensively upon them. And every proprietor of sound natural taste will, in a case of this nature, plant the different sorts of hardwood, with the view of their becoming ultimately his permanent standing trees, and make up with coniferous ones, simply with the view of acting as nurses, until the hardwood sorts arrive at a size sufficient to insure their welfare, independent of them; and not plant coniferous trees in a body by themselves, in any plantation near the mansion, or in the grounds immediately in view, for these always give a place a mean and highland appearance.

1046. I am aware that many proprietors in Scotland, whose seats are upon high-lying and rather moorland districts, are of the opinion that hardwood trees will not grow with them to a size worth cultivating with the view of becoming ornamental lawn-trees. Upon this point my experience points to quite a different conclusion. In all high-lying situations in Scotland, where the Scots pine and spruce firs are found to succeed well—the former on the heights and the latter in the hollows—the beech, oak, elm, and ash will thrive well also, and become trees of no mean magnitude. This I have observed in the northern parts of Scotland, as also on the highest-lying districts in the south of Scotland and north of England; therefore no proprietor, if he can produce upon his estate Scots pines of good size, should hesitate to plant the kinds of hardwood trees above named. All that he has to do, in order to insure success, is to plant pines or larch as nurses along with the hardwood, and remove them by degrees as the others advance.

1047. It is allowed by all people possessed of good natural taste, that pines, when planted in a mass, and forming a plantation near to a gentleman's mansion, without a proper body of hardwood trees, give that place a cold, heavy, alpine appearance, although it may be situated in the most fertile part of the country. And it is my opinion, that every proprietor of land should endeavour, as much as possible, to cultivate all the different sorts of hardwood within the range of his home parks, which will give his grounds a fertile and cultivated aspect, although the situation he may occupy be naturally one of an opposite character. All plantations of coniferous trees should be kept out upon the poor high grounds of an estate; and by the arrangement of having the hardwood trees in the centre of the property, and the others upon the outer grounds, the whole will have a most natural and imposing effect.

1048. Wherever a young plantation is made of hardwood and pines, with the view of their ultimately becoming ornamental lawn-trees, they should, in every respect, be treated in the same manner as already advised for forest hardwood trees, until they arrive at the period when they require to be thinned for the first time. The hardwood which are intended for lawn trees should also be brought into shape by receiving a judicious pruning previous to being thinned for the first time, as has been advised elsewhere; and when those which are intended for lawn standards are thinned, they should have, at all stages, much room and space to spread out their branches and develop themselves according to their nature, which is the state in which trees always appear to best advantage. In order to allow the young hardwood trees to attain their natural shape as much as possible, the nurses which may be planted about them should be kept well off them, and never allowed even to touch their branches, but placed so as merely to stand by their sides, and give the benefit of their shelter. As soon as they approach each other closely, the nurses should at once be sacrificed. At the same time, however, care must be taken that this is done gradually; perhaps looking over and taking out a few every year, as occasion may require, and as the hardwood trees advance.

1049. The great art in rearing up hardwood trees for lawn scenery is, first, not to prune off any branch after the trees are fairly established in the ground, and about eight or ten feet high. Second, the sorts which act as nurses, should never be allowed to spread themselves upon the branches of the hardwood, but should merely stand by, for the sake of shelter. Third, observe what sorts of hardwood trees appear to thrive best upon the ground, and encourage those most which appear to do best; and, at the same time, wherever any particular sort of hardwood does not appear to do well upon the soil, leave pine, fir, or larch in their place: a few good specimens of these look well among hardwood. Fourth, when the hardwood trees have advanced so as to require all the nurses to be removed to give them room, and when they begin even to encroach too much upon each other, cut out several of them also, and continue to do so until the trees have attained the age of from forty to fifty years, after which period it will not be found necessary to thin much, if they have been well attended to previously. Fifth, in the act of thinning out trees intended for park and lawn scenery, care should be taken that picturesque openings be made here and there, for the sake of distant objects to be seen from the mansion; such as a particular plantation upon a height, a romantic view of an old ruin, or a sheet of water in a neighbouring hollow; all of which are beautiful objects in landscape scenery, and should never be hidden from the mansion and grounds of the proprietor; for, however beautiful trees may be in themselves upon a lawn, they form but a dull and monotonous scene if well-chosen openings are not left among them, through which other interesting objects may be seen.

SECTION VII.—SYSTEM OF THINNING AND REARING OF MIXED SCOTS PINE, LARCH, AND FIR PLANTATIONS.

1050. In order to point out properly the manner of proceeding with the thinning of mixed pine and fir plantations, it will be necessary to give a detailed account of how the work should be done at the different stages of the age of any plantation ; and, as I have already stated that no particular age of a young plantation can be given as that at which thinning operations ought to commence upon it, the observation of the operator must always be his guide in such a case. Every man who has given his attention to the rearing of forests must have observed, that on some particular soils and situations a young plantation may be in a fit state for thinning at eight years of age, while another, composed of the same sorts of trees, and planted at the same time, may not be ready for this operation at nearly twice that age—all depending upon the elevation of the situation, the nature of the subsoil, as that is open or retentive, dry or damp, and also in a great degree the extent of the plantation itself. Therefore it is that observation upon the spot is the only decisive way of ascertaining when a plantation is in want of being thinned.

1051. I may state that, at the present time (1859), in the forest of Abernethy, in Strathspey, we are thinning a pine and larch plantation for the first time, which is fourteen years planted. The situation is nearly one thousand feet above the level of the sea, and notwithstanding that altitude, the trees are of the most healthy character possible, and promise to do well, although of a slow growth. Another pine and larch plantation, in the same neighbourhood, was made in the autumn of 1854, being at the present time (autumn 1859) of five years' growth. The trees in it are not more than thirty inches high upon an average, and yet they are in most perfect health, and promise to do well. This young pine and larch plantation will not, I conceive, be ready for the first course of thinning much under fourteen years of age. These remarks are made to show that the time for the thinning of any plantation for the first time depends much upon the altitude of the situation, and upon the nature of the soil, as well as the part of the country in which it is situated.

1052. For the guidance of those who may not have had much experience in the thinning of pine and larch plantations, I shall here lay down a few hints of practical utility, from which I am certain a cautious, intelligent man may be enabled to lay the foundation of future experience in this art. In examining the state of a young pine and larch plantation with the view of ascertaining if it be in a condition so far advanced as to admit of being thinned, it will be necessary first to walk very carefully through its whole extent, and mark well the bearing which the young trees have one upon another. If the points of the branches of the young trees be merely touching, or slightly interfering with one another here and there, thinning would be premature, and ought to be put off for a year longer; but if, upon examination, the lower side branches of the trees have the appearance of having been somewhat checked in their growth, and are becoming weakly in the extremities from the want of freedom and air, and if the higher branches of one tree are spreading widely, and actually encroaching and lying partly upon those of another, it is high time that thinning should be commenced. If the lower branches of the young trees have a brown and deadened appearance, and the upper are spreading so widely that in many instances the points of the strongest of them touch the stems of others, thinning has been delayed too long; and from the trees being heavy topped, and light in the lower parts, many of them would be apt to be blown down if thinned suddenly: therefore, thinning should never be delayed so long as to allow the last-mentioned feature to manifest itself upon the trees.

1053. Having in the manner stated gone through the young plantation, and determined as to whether it ought to be thinned or not—supposing that it has been found requisite to thin, it will be necessary, previous to commencing operations, to examine which sort of tree has thriven best upon the ground, and has the appearance of becoming the most valuable for a permanent crop of timber. Thus, if the ground has been originally planted with a mixture of Scots pine, larch, and spruce firs, examine each district of the plantation as it may naturally divide itself into height or hollow, sloping banks or level ground, and ascertain which variety appears most healthy, and is most likely to come to perfect maturity as a timber tree in each separate district. In each district spare that species which, from general appearance, is most likely to succeed well; and when thinning, remove those sorts which have not the appearance of becoming good timber upon the soil.

1054. In commencing to thin any plantation, it is also necessary to have in view its situation. The operator should observe that, if the situation be a high one, he must thin sparingly at first, for fear of checking the growth of the trees. At the same time regard should be had as to what winds prove most violent and destructive in the neighbourhood of the plantation; and having ascertained the quarter from which the most injurious winds come, it is wisdom to thin most cautiously upon that side, and more severely in the interior of the plantation. But if shelter is given either naturally, by surrounding hills, or artificially by older plantations upon other heights, then less caution is necessary, and the trees may at once be allowed more freedom, in order to develop themselves quickly and perfectly. The operator having fully informed himself upon each of these points, he will next proceed to have those trees marked which it is considered should be taken out.

1055. In the act of thinning, particular attention should be paid to leaving, in all cases, the healthiest trees upon the ground, and to cutting out those that are most weakly, as the nature of the thinning may require.

1056. In thinning a plantation, many foresters think that the principal object to be aimed at is, that of giving the whole a regular, systematic appearance, by leaving the trees as nearly as possible at a given distance one from another, without taking into consideration the ultimate welfare of the plantation. Such a method of conducting thinning operations may, indeed, have the effect of pleasing the eye and taste of the inexperienced for a time; but the effect is certainly ruinous to the proprietor in the end, and is never practised by the forester of extensive experience. If the trees in a young plantation are all equally healthy, then it is but proper to thin them out to a regular distance from one another; but where many of the trees appear of an unhealthy cast—which is frequently the case in most situations—the healthy trees should be preserved without respect to a nice regularity in appearance. Wherever two trees may be found growing together, the one healthy and the other unhealthy, and, according to regularity in the act of thinning, the unhealthy tree may be found to occupy a proper place, and the healthy one an improper, yet, for the sake of the future welfare of the plantation, there should be no hesitation as to which should be cut down. In all such cases, at once cut out the sickly, and leave the healthy.

1057. In the thinning of young mixed pine and fir plantations for the first time, it may be asked at what distance the trees should be left the one from the other? No certain distance can be specified: for this reason, that the young trees do not all grow alike in the same plantation, either as regards height or breadth of branches; consequently, they do not all occupy the same space upon the ground. In the first thinning of any plantation of considerable extent, it will often be found prudent and necessary to pass over some parts altogether, without taking out almost a single tree; and this will happen upon a part of the ground which is of a poor thin nature; while again, wherever the ground is of a stronger nature, with a little shelter from the higher grounds, it may be found necessary to take out nearly one-third of the trees in order to give proper air and room. All this must be regulated by observation more than by any rule that could be given. As the general rule, however, my own method of procedure is, to leave the trees, as nearly as possible, *free from one another* after the thinning has been performed: that is, when a plantation of young trees has been newly thinned, the extreme points of the branches of one tree should be quite free from those of its nearest neighbour; and in all cases where coniferous trees are raised for timber as well as for shelter, they should be kept rather close together than otherwise. By observation, the most advantageous distance will be found, as I have formerly mentioned, to be about one-third the height of the trees generally. When coniferous trees are kept growing at a distance less than one-third of their height, they become tall, slender, and weakly; and if grown at a much greater distance, they become branchy, and do not increase proportionately in height, and the timber is generally coarse.

1058. No pruning of pine, larch, or fir trees should be allowed: pruning invariably deteriorates the quality of the wood of such trees, and their health also is much injured by it. If the trees are kept as nearly as possible at the distance specified above, they naturally prune themselves as they advance in height; for as soon as the lower branches of the coniferous tribes become confined, and a want of free air ensues in the body of the plantation, they gradually die and fall off, without in the least injuring the quality of the timber. All the ends or stumps, however, of dead branches, should be carefully removed from the stems of pine, larch, and fir trees, and that as soon as they become deadened; this tending to make the quality of the wood much finer.

1059. In the act of thinning, great care should be taken that no large open space be left among the trees, which in any direction would in length measure more than the height of one of the trees growing by it. This can easily be avoided by proper attention in the disposal of the trees upon the ground, not to have them running in rows, but in such an alternate manner that, which way soever the eye looks from any given point, there may be always a tree to intercept the view within a short distance. This, indeed, is a point of the utmost importance in the art of thinning plantations, and can only be attained by careful observation and experience. If open spaces be left for any considerable distance, the wind gets play among the trees, and has a tendency to cause havoc among them, particularly after being newly thinned, and the more so if the plantation has been formerly neglected. As soon as the young trees which were marked to come out have been cut down, they should be carried out entire to one of the nearest roads in the plantation, and pruned of their branches there. This is not, indeed, always done; but still it ought to be the method of going to work among young trees, the health of which requires free circulation of pure air among them.

1060. I have often had occasion to remark that plantations in a young state are much benefited by having a dry wholesome air circulating through them; and being aware of this fact, it must appear evident, that if the prunings of the felled trees be allowed to lie upon the ground when they are cut, the gases arising from their natural decomposition must prove injurious to the health of the standing trees. This is particularly the case when plantations are composed entirely of one tribe or family of trees; that is, if a plantation be composed entirely of the different sorts of cone-bearing trees, the gases arising from the decomposition of their own kind is injurious to their health, whereas those arising from their decomposition are favourable to the health of hardwood trees. On the other hand, the gases arising from the natural decomposition of hardwood trees are injurious to the living plants of the same species in the neighbourhood, but the same gases prove beneficial to coniferous trees. The reason of this I do not pretend to explain, as a question of chemistry is involved in the answer; still, from my own observation, I am satisfied of the truth of what I here assert, although I do not remember of ever having heard that any other forester had observed this phenomenon: and it is to be regretted that, generally speaking, foresters are not allowed time and expenses to keep young plantations in the clean healthy state which their ultimate value demands. I have observed, in several places of note in Scotland, where men of first-rate abilities acted as foresters, that the plantations under their charge, although generally well conducted in other points, were, notwithstanding, always in a confused state from the prunings of all felled trees lying upon the ground; and on inquiry into the reason of such a state of things, I have always learned that the operation of keeping plantations clean being an expensive one, they were not allowed strength of men sufficient to make all right. Proprietors of plantations often lose much valuable timber by this state of things being allowed to go on in their plantations. It does, no doubt, demand a few more pounds of outlay at the time, but ultimately that would be paid to their successors ten times over, from the effects of a superior system of management.

1061. Supposing that a plantation of young pine, larch, and fir trees had been thinned in the manner above recommended, when about twelve years old, the trees would then, probably, be from eight to twelve feet high, according to soil and situation; and supposing that the same plantation was then in a fair state of health, and to have continued so for another period —say of three years from the time that it was first thinned—it would, at the end of this second period, be about fifteen years old, with the trees from twelve to eighteen feet high; and they would, in all probability, be ready at this age for another thinning. In the thinning of the same plantation a second time, the same practical points relative to the work must in all cases be attended to as have already been recommended for the first thinning; consequently these need not be repeated here. But there are one or two points which must be observed by the operator in the thinning of plantations approaching to or above twenty years old: the first of these being to see that the standing trees are not injured by the falling of those that are cut down. I have seen much damage done to the trees in a young plantation, where the falling down of the cut trees was carelessly conducted; and it cannot be too strongly recommended to all operators, in the act of cutting down any tree of considerable size and height, to be most careful in the operation. When a pine or fir tree happens to lose its top by a felled neighbour coming in contact with it, such a tree seldom or never increases any more in height, and very frequently dies. The operator, in the act of cutting down any tree of such weight of branches as may be considered dangerous to let fall against any of its neighbours, should, if he has not a sufficient opening for its safe fall, provide himself with a pruning chisel, having a shaft proportioned to the height of the tree, and also a mell; and with these he should lop off all the heavy branches from the tree to be felled, previous to its being cut. When it is thus made bare of all its branches, any tree of fifteen years may be at the command of a man's strength, in so far as he may be enabled to push it down to one side or another as he may see fit, to suit an opening among the standing trees. The lopping off the branches from a tree of any considerable size, is, however, an operation requiring considerable time; consequently it need not be adopted excepting in extreme cases, where there is evidently danger to the young and growing trees.

1062. In most cases an expert woodsman can, from observation and practice, make a tree fall very nearly to any given point he may choose as an opening of the safest description. The method practised by expert woodsmen in this sort of work, is to observe, first, toward which side the tree he may be about to cut has naturally its centre of gravity. Having ascertained this point, he proceeds to judge if the tree will or can be made to fall into a proper opening among the growing trees; and being from observation well assured as to the side to which the tree can be made to fall with the most safety, he commences to cut first upon the side to which he wishes it to fall. After cutting rather more than half through upon that side, so as to throw the centre of gravity in the desired direction, he next applies his axe to the opposite side. As he gradually weakens the perpendicular attitude of the tree, he observes now and then if the centre of gravity in the tottering tree is likely to take an unexpected turn upon him; and if so, he checks the same by cutting oppositely. By these means alone I have had men who could lay down trees upon the ground to almost any given point. But, notwithstanding all this, I have frequently had to do with instances in the thinning of plantations where the coming down of a heavy-topped pine or fir tree would have done much damage; and in such cases, when I applied the chisel in the manner above stated, the work was safely accomplished.

1063. At the age proper for the second thinning of any mixed plantation of coniferous trees, it should never be too severely thinned; because at such an age—say at about fifteen years old—the trees are generally in a very healthy and rapid state of growth; and if they should happen to be checked at such a stage, the ultimate value of the whole plantation might be materially impaired, and it is even possible that the whole might be ruined. Hence it is requisite, in all cases, to thin with experience and caution.

1064. It is always better to thin frequently, and take out a few trees at a time from any given plantation, than to thin at distant periods, and then to do so severely. After any young plantation has been thinned for the first time, it is advantageous to its welfare to go over it and take out a few trees in the way of thinning at intervals of three years. At such thinnings I would advise every forester merely to take out such trees as are really doing injury to others. By this method, which I now always practise myself, plantations never experience any sensible check, and, consequently, they are kept in a constant quick-growing state; whereas, by the method of thinning at irregular intervals, and without system, they are generally allowed to stand unthinned too long, and thereby the trees in a plantation are generally hurt to a very great extent from the effects of confinement.

1065. Every plantation of the mixed description under notice ought to be gradually thinned as the trees advance in height and breadth, until they are from forty-five to fifty years of age, after which period no such plantation which has been properly managed should be at all disturbed by the operation of thinning, excepting the taking out injured, unhealthy, or decaying trees. At from forty-five to fifty years of age, the trees in a mixed pine and fir plantation should stand at such a distance one from another as may be considered sufficient to bring them to confirmed maturity upon the soil upon which they are growing. This distance of the trees one from another should, as I have formerly stated, be about one-third of their height; and, indeed, this ought to be as nearly as possible the rule for distance among such plantations at all stages of their growth, commencing our calculation with the time the trees receive their first course of thinning.

In many high-lying districts, the trees in a plantation of mixed conifers may, at the age stated, be about thirty feet high; therefore, the distance of such trees at that age should be as nearly as possible ten feet: in a more sheltered situation, with a dry and favourable subsoil, they may at that age be about sixty feet high; and in such a case, the distance of the trees one from another may be about twenty feet.

1066. At from sixty to seventy years of age, the wood of the pine and fir tribes is generally considered to be in its most valuable and solid state as timber. It is then heavier and more full of resinous matter than at any other stage of its existence; consequently, at that age, if the object be a crop of valuable timber, the tree should be cut down, and disposed of as may seem best. But if the proprietor have in view the giving shelter to his lands, which is generally one end aimed at, the plantation may be allowed to stand for other twenty years, after which period the trees will begin to become lighter in their wood, and many will then be showing marks of natural decay, and the whole plantation will of course be, generally speaking, of less value than it was at sixty years' standing. However, this is not always the case, for very much depends upon the nature of the soil and situation upon which the crop of wood may be growing, as to whether that may be high or low lying, dry or damp. In a high situation, with a good dry bottom, I have seen excellent pine trees one hundred years old; while on the other hand, I have seen them beginning to show symptoms of rapid decay at fifty years of age, and in many cases even at a much earlier age, where they were in a low and rather moist situation, and without a free circulation of air from neglect of thinning.

1067. It very frequently happens that mixed pine and fir plantations have to be dealt with which have been much neglected; and although they may in many instances be past any good hopes of recovery, and might, in so far as regards the value of their timber, be very properly cut down, yet it is very often the wish of the proprietor to have such old plantations preserved, particularly if they should happen to be placed upon a part of his estate where, from their evergreen appearance, they prove ornamental from a certain point of view, as well as shelter the neighbourhood. In such a case profit and ornament should be combined. It would not be profitable for the proprietor of an old neglected pine plantation to leave the ground entirely occupied by a few trees only in a fair state of health, with many others dead and dying; therefore, the profitable way of going to work in such a case would be to plant anew with other trees all vacant parts, and, for the sake of ornament and shelter, all good old trees could be left for a time.

1068. I have frequently been called upon by proprietors to give my opinion relative to the state of pine and fir plantations upon their estates which had grown up under utter neglect, and requested to say whether I thought that such a plantation would recover by any means I could suggest. Where I have found such plantations young—say at or under thirty years of age—and spoiled merely from the want of having being thinned in proper time, I have very often seen them recovered by a very cautious and gradual course of thinning, especially where the trees grew upon a dry bottom; but wherever I have found thinning neglected upon a damp soil, I at once pronounced that there was no hope of recovery for the trees. In many such cases I have seen a gradual course of thinning with draining tried for the purpose of recovery, but all to no purpose. If ever the pine or fir tribe have been much affected by dampness in the soil, the sooner that the trees are cut down the better, after which, draining and replanting can be done in a proper manner.

1069. Where the trees in a neglected pine and fir plantation may happen to be old—say at or above sixty years—and where, in such a case, it is the wish of the proprietor to extend the existence of his plantation as long as possible for the sake of shelter and general ornament, it is a very good method to cut out gradually all the trees which have the appearance of decay, and to leave the best trees standing at wide distances, and as nearly regular as possible. Say that good trees are left at about one hundred feet distance one from another, from a distant view the plantation would seem good; and then the open spaces between the old trees could be replanted with a crop of hardwood, which, from being sheltered by the old trees, would grow very rapidly. In the course of ten or fifteen years from the time of this replanting, when the hardwood may be expected to be pretty strong, the old crop might with propriety be dispensed with altogether, or only a few of the best trees left, according as the taste of the proprietor suggested.

SECTION VIII.—SYSTEM OF THINNING AND REARING OF SCOTS PINE PLANTATIONS.

1070. Plantations consisting of several kinds of trees intermixed, whether hardwoods or coniferous trees, are always more difficult to manage judiciously in the way of thinning than such as consist of one species alone. Hence it is found, generally speaking, that it is most advantageous, in respect to the ultimate value of a crop of trees, as well as saving in the expense of training, to plant the crop of a plantation as much as possible—taking all circumstances in connection with it into due consideration

—of one sort of tree only; and if of more than one sort, in masses of each separately, to suit soils and situations.

1071. In reference to coniferous trees, each of them, as well as the hardwooded sorts, has its own peculiar habit of growth; the larch being of an upright airy habit, and its light branches having very little tendency to injure other trees standing near it; the spruce and silver firs, on the other hand, are also of an upright habit, but from their throwing out stiff, horizontal branches, densely clothed with hard persistent leaves, they invariably injure other sorts standing near them, if not kept within due bounds; while the Scots pine, being naturally disposed to throw out strong and pendulous branches, is also apt to injure any other tree of a more slender habit of growth. When, however, each of these kinds is planted in masses separately, from the habits of all the trees in each mass being alike, the one cannot injure the health of the other nearly so readily as when composed of different sorts, where those of a stiff, unbending habit, such as the firs, invariably have a tendency to encumber such as are of a more pliant habit, as both the pine and the larch. I make these remarks to show that a great advantage is gained by planting trees in masses of one sort, both in respect to the general health of the crop itself, and in respect to the less amount of attention and expense necessary to be bestowed in training, and also to show that the thinning of plantations composed of pine alone, or of any other sort, is a much more simple operation, and requires less judgment in the operator, than when they are composed of several kinds of trees.

1072. In planting trees in masses of one sort, however, a much greater degree of judgment is necessary in the planter to adapt the sorts to the soil suited to them than is generally called for in the case of mixing several sorts together; as if the one tree planted should not be properly suited to the land, a partial or an entire failure might be the result, while if several sorts had been intermixed, some one of them would be sure to succeed. This point, then, demands the serious consideration of the planter.

1073. In thinning a plantation consisting of pine alone, from the trees being generally of a uniform habit of growth, the work is comparatively of easy performance, and only requires proper attention to remove, at each course of the operation, such of the more weakly trees as encumber or interfere with the development of the more healthy and promising ones.

1074. The whole of the plantation should be gone carefully through as each successive thinning falls to be made; and wherever the trees encumber one another, a judicious selection should be made of the strongest and most promising to stand regularly over the ground, at proper and consistent distances apart, according to the age at the time, and all inferior ones should be removed, so that after each course of the operation every tree shall be left standing quite free of its neighbours in the spread of its branches, but no more.

1075. In thus thinning a pine plantation, the work should be begun on one side of it, and proceeded with by taking on regular belts—in breadth according to the number of hands employed—from the one fence to the opposite one, till the whole is gone over, and no part should be neglected or overlooked. In going over the plantation in this way, all rough and unpromising trees should be removed, and well grown ones left instead, as rough branchy trees of the pine tribe are never valuable as timber; and any trees that may have lost their tops by accident should be removed also, as such cannot possibly make good trees afterwards.

1076. After the thinning of any one plantation has been completed for the time, and after the produce of it has been removed, all drains should be scoured out so as to leave them in good operative state, and in the act of thinning care should be had to prevent branches falling into them; and after the felled trees are all removed from the enclosure, the roads should be made good, so as to present a uniform, neat appearance.

1077. There is no season of the year so advantageous for the thinning of plantations as the months of March, April, May, and June; as when the operation is performed within these months, the crops operated on have the advantage of the summer weather afterwards to grow freely, and to attain a greater vigour of health before the storms of winter set in upon them, and as the opposite of this must follow to the trees in a plantation thinned in the autumn.

SECTION IX.—THINNING AND REARING OF FIR PLANTATIONS.

1078. The cultivation of the fir tribe in this country is on a small scale as compared with that of the pine, few plantations of any considerable extent ever being made exclusively of it, but only portions of large enclosures, where few other trees would grow so profitably as a crop; as in the case of the spruce on moss land, and the silver fir on dry, sandy, or gravelly knolls; for growing on which situations these trees are admirably fitted. The timber of both these firs is, however, valuable when grown of proper dimensions; and as the waste parts of the country are cultivated, and partly put under trees, we find this class well adapted to grow usefully when properly planted in groups on land suitable for them in large enclose-ures. I therefore consider it may be proper to devote a short section to the manner of thinning and rearing these trees, not so much with a view to describe all the routine of their culture—as that is generally very much the same as the culture of the pine tribe—as to point out any peculiarity in reference to them that may be necessary to attend to in the mode of thinning them.

1079. Compared with the larch and pine, the fir is of slow growth during the first three or four years after it is planted out, but after its roots become properly established, it makes very rapid progress—not unfrequently thirty inches of upright shoot in one year—and generally outstrips the pine after the first six or eight years.

1080. The roots of the fir keep nearer the surface of the land on which they grow than any other coniferous tree we are acquainted with; hence they succeed well upon a thin surface soil, although cold and wet in the bottom. From this peculiarity, however, the trees are very apt to be blown down by severe gales of wind if not judiciously attended to in respect to thinning. In order to prevent this, they should at all stages be kept pretty far apart from one another, so as to allow of the free and undisturbed spread of both their roots and branches, as no other condition is so likely to keep them in perfect health, and prevent them being blown down.

1081. In commencing to thin plantations, whether of spruce or silver fir, great care must be taken not to delay the operation till the branches of one tree interfere with those of the other, at least to such an extent as to impede their healthy action; as if so, the branches, from their being naturally slender and comparatively weak, will suffer in health, and consequently fail to keep the trees in that degree of health which is absolutely necessary for their full development. This point, then, should be most carefully attended to, and thinning commenced before the points of the lower branches of the trees begin to injure one another. At each successive thinning the same point should be carefully attended to, and every individual tree kept apart, and distinct in every respect from its neighbours.

1082. The silver fir will endure a greater degree of confinement, without much injury, than the spruce; but both are extremely impatient of want of space. In rearing timber of the pine tribe, it is, in practice, found desirable to check the luxuriant growth of the branches, as, when unchecked by judicious confinement, they become unduly strong, and lessen the value of the timber. This is not the case, however, in regard to the firs—and this forms the great distinction between them: their branches, although freely exposed on all sides, never become so strong as to interfere with the upright growth of the leading stem, nor even so much as to impair its fullest development, but rather the contrary; for we invariably find that the more the branches of the firs are encouraged by having space, the larger and the better is the timber of the trees. These are the only points I think it necessary to advert to in regard to the rearing of the fir. They are important, however, and if not attended to, the trees will be comparatively weakly and unsightly as a crop, as well as valueless as timber.

SECTION X.—THINNING AND REARING OF LARCH PLANTATIONS.

1083. In planting a large piece of land exclusively with larch, the planter should be very careful to ascertain first that it is in every respect adapted to grow the tree to valuable size, as no tree we cultivate is so easily injured in health when planted on an unsuitable condition of soil. From this tendency of the tree, the greater number of planters at the present day seem more disposed to use it as a nurse to hardwoods, or as an intermixture with the pine, than as a tree to be planted exclusively as a crop. This is a mistake, however, in the forestry of the time, as can be easily proved from the excellent crops of larch found growing in a sound and healthy state, in all varieties of soils, and in all situations, wherever the condition of the land is either naturally, or has been rendered artificially suited to it. This condition consists simply and mainly in the particles of which the soil is composed being *kept in a clean and wholesome state,* by the ready passage of rain water through it.

1084. There are, indeed, few soils on which the larch may not be grown satisfactorily, provided that their thorough drainage is attended to previous to planting. The great mistake in regard to the cultivation of the larch in this country has been the planting of it on lands in which were lodged ingredients prejudicial to the healthy growth of the tree, and which had not been cleansed away by the action of drainage. This is a fact not now to be doubted, as on all soils that have been properly cleansed by drainage, larch is found to succeed satisfactorily, even although on the same soils it failed to grow previous to drainage. From my experience on this point, therefore, I recommend proprietors not to be deterred from planting larch extensively, even without the intermixture of any other tree, provided the land is thoroughly cleansed by the action of a well-applied system of drainage some time previous to planting.

1085. The land intended for larch having been well drained, and allowed to lie under the action of the drains for some two or three years, according as it is naturally open or otherwise in the subsoil, it should next be planted with that tree, say at four feet apart, and when the plantation has attained from eight to ten years' growth, it will probably be so far advanced as to stand in need of thinning for the first time. This thinning should be conducted in every respect as detailed in reference to the thinning of the Scots pine.

1086. The larch being a tree clothed with slender branches and soft delicate leaves, is easily injured by confinement. The trees therefore require, at all stages of their growth, to be kept apart from one another in the plantation. If this point is not attended to, and the trees, especially while under thirty years of age, are allowed to become crowded, their roots and branches will both become weakly and impaired in their healthy action, and the result will be *rot in the heart.*

1087. The larch is at all stages extremely impatient of confinement; hence we find in the greater part of mismanaged plantations of this tree, the branches, for a considerable way up the stems, either dead, dying, or diseased, and the trees only struggling for existence by having air and light for their tops. In such a state no tree can possibly grow healthily, and from this arises much of the disease in the tree we hear complained of.

1088. At each successive course of thinning a larch plantation, the object should be to leave the branches of every tree standing perfectly clear of all those of its neighbours, so that each tree in the plantation may stand in every respect unencumbered on all its sides.

1089. After each successive thinning has been performed, all branches that may have died should be removed, by simply breaking them off close to the stem with any blunt instrument. But what is of far more importance to the health of the crop, is to have all drains thoroughly scoured out, and every one left in a clean and fully operative state. This latter point is too little attended to even by the most intelligent foresters, and hence, to a very large extent, the cause of the generally inferior crops of larch. It is, in fact, no uncommon thing to find the drains in a plantation left uncleaned after it has been thinned, with large quantities of branches lying rotting in them, and causing stagnant water. Under such a state of things, no tree could possibly grow satisfactorily.

SECTION XI.—SUGGESTIONS AS TO THE MODE OF DISPOSING OF THINNINGS, AS THEY ARE REMOVED FROM THE STANDING CROP.

1090. The trees felled as thinnings in a plantation, whether the latter be large or small, young or old, should never be allowed to lie where they fall, but should be at once carried out to the nearest roads, and arranged there according to their kinds and sizes, when they will be ready for sale, or otherwise, as may be found desirable. Our own mode of going to work in respect to the felling and carrying out of the thinnings from a plantation is this:—As the trees are felled by one set of men, we have another who follow them, and either carry or drag the trees to the nearest roads. The latter set may be women or boys, if the trees are small, but men are required for the work if they are large; they carry them on their shoulders, if able, or drag them out with horses if of sizes too heavy for them to carry.

1091. If the work to be performed is to any large extent, it may very properly be done by contract; provided always that the forester is an intelligent and experienced man, and can see to its being properly executed; as, by contract, there is great danger of having it carelessly performed, and very often to the damage of a considerable portion of the standing crop. In order to obviate damage being done to the crop from carelessly felling the thinnings, I generally recommend that the work should be done by the proprietor's servants, under the superintendence of the forester; still, where there is a large extent to operate on, it is sometimes found desirable to have the whole done by contract, as by this means it is generally got performed twenty per cent cheaper than by day labour.

1092. When I came to take the management of the Strathspey forests, I had all our thinning operations done by day labourers, employed directly under the forester. Having a large extent to get over within a specified time, however, I found great difficulty in getting hands enough for the work of felling, &c., so that, at the end of the season, I found it cost much more than had been calculated upon. The following spring I took in estimates for the work, and from this had it performed twenty per cent under the cost of the former year; and since then we have continued to thin by contract.

1093. In thinning our plantations, the forester marks every tree to be felled; the contractor for the felling follows him with his men, and cuts down and prunes the trees, at a certain rate per hundred, according to size, and according to agreement in reference to the trees of a certain plantation; and the contractor is in all cases bound in a penalty not to injure any standing tree not marked to be felled. Another contractor follows the one who fells the trees, and drags them all out to the roads, also at a certain rate per hundred; and he is also subject to a penalty if he injure any standing tree. By this mode of doing the work by contract, we have it accomplished at the cheapest possible rate, within a given time; and from being all done under the eye of the forester, whom we hold responsible for its right performance, we have it generally very satisfactorily executed.

1094. We generally enter into a contract with a party for the thinnings of a plantation before we cut the trees, so that by this means we know perfectly what we are doing in all the departments of the work. This is now easily obtained, as there are always timber merchants enough anxious to purchase wood of every description, especially when it can be had in large quantities.

1095. If the thinnings of a plantation are of small sizes, and generally under *propwood* dimensions, we dispose of them at a certain rate per hundred or per thousand trees, according to bargain previously entered into. If they are of sizes for propwood—viz. not less than three inches diameter at the small end, six feet up from the bottoms—we sell either by the dozen trees, by the hundred trees, by the prop of six feet length, or by the hundred lineal feet, as may be agreed upon. If they are of sizes above propwood, but under timber—that is eight inches diameter at the small end—we sell them either by the tree, or by the dozen trees; and if they are of timber size we sell them at a certain rate per foot cube, according to the quality and kind, and according to the locality the plantation is in. And in all cases we have the purchaser bound to remove the whole by a certain day; or, failing this, he is liable to a heavy penalty. By adopting this mode of procedure, we never are subject to have cut wood lying unsold in the plantations; while, at the same time, we are enabled to calculate our way in the different branches of the work most satisfactorily, which cannot be so well done when the trees are first cut and sold afterwards.

1096. Such a mode of procedure is not indeed so necessary for the proper management of the disposal of thinnings in woods situated in the neighbourhood of populous districts; as, in such, a public sale of them after being cut is generally found the best mode for realising the highest value for them. The case, however, is very different in parts of the country at great distances from a ready market, and it is for the benefit of foresters so situated that I have made the foregoing remarks, as I have frequently seen men who had the management of extensive woods in far inland parts seem to have great difficulty in getting their thinnings disposed of advantageously, and only because they did not attend to enter into proper arrangements beforehand. I have known proprietors who would not be at the expense of thinning their plantations, because, they said, the sale of the thinnings would not pay the labour. I put them on the mode of going to work which I have just described; and the result is, that now those very proprietors are realising very considerable revenues from their thinnings, while previously they could make nothing of them. I have no doubt, therefore, that the foregoing remarks will prove advantageous to such as have to deal with woods in parts of the country comparatively far distant from a ready market.

1097. In conclusion on this head, I may state that no proprietor whose woods are far distant from a market should thin his plantations without first entering into contract with respectable parties for the sale of his thinning; as, if he do, he is likely to lose by the work. I do not, of course, here refer to the gain in respect to the effects of the thinnings upon the plantations themselves, but only to the thinnings as a saleable commodity. No sensible man, so circumstanced, should attempt this in these times; as when timber merchants are called to give an offer for wood in the cut state, from the very fact of its being cut, and therefore in a perishable state, they will not offer its value if they can help it, but will offer far under it, in order to make the most they can by the transaction; but when men are asked to give offers for wood or trees growing, they see that the proprietor is not compelled to sell in the meantime unless he pleases, and they therefore are more disposed to deal fairly, from seeing that if they do not another likely will.

CHAPTER VIII.

SECTION I.—MANAGEMENT OF HARDWOODED PLANTATIONS OF CONSIDERABLE AGE, REARED CHIEFLY WITH A VIEW TO ORNAMENTAL EFFECT.

1098. The relative condition of trees in a plantation of considerable age—say upwards of sixty years—and reared avowedly with the design of their forming clothing for the home park of the mansion of an estate, will depend altogether upon the training and management they may have been subjected to previously. If they have been regularly attended to, and systematically thinned in the way which has been advised in former sections, they will, by the time they are above sixty years of age, be fine, healthy, and well-developed trees of their several kinds, every one standing clear of and unencumbered by another, and still making progress. But if they have not been attended to in this way, they will, at the age stated, in every probability be tall of stem, small topped, weakly, and unhealthy from crowdedness and consequent want of air.

1099. Where trees have been properly attended to and well thinned while in their young stages—say especially while from fifteen to fifty years of age—there is comparatively little danger of their getting wrong afterwards, as the strength of constitution which such management secures for them enables them to resist the effects of after mismanagement to a wonderful extent, as I have had frequent opportunities of witnessing in the case of woods that had been well managed while under one proprietor, and afterwards neglected when they fell into the hands of another who paid no attention to such matters. Where, on the other hand, trees have been neglected while in their young stages, no after-system of management, however judicious, can possibly be of much benefit to them.

1100. Assuming that plantations of the hardwooded sorts of trees, reared with the object of their becoming ornamental specimens on the park and its neighbourhood, have been attended to and properly thinned up to the age of sixty years, the only after-management necessary is to clear away from time to time any inferior tree, as it seems to interfere with or encumber a better one in its neighbourhood, to bring any very fine specimen more decidedly into view, by cutting down others that stand near it and intercept the view of it from particular points, to relieve the masses by grouping here and there on well chosen points, and by partial clearings on others between, and to keep all the trees clear of such branches as may happen to die from time to time.

1101. Where plantations of hardwooded trees, occupying the position of ornamental ones, have been neglected while in their young stages, it is impossible, as I have said, that any system of management can recover them to any considerable extent; but of course this remark is only applicable according to the degree of neglect that the plantations may have existed under; as, if they have been partially attended to, the crops will of course be partially recoverable, while, if they have been allowed to grow up in an utter state of neglect as to thinning, the case is without remedy.

1102. The only sensible way to improve the crop of a neglected plantation, and which it is found desirable to preserve as long as possible, in order to keep good the amenity of the neighbourhood, is to single out all the most healthy and promising trees in it, and immediately afterwards to relieve them of all such inferior ones as encumber them. This, however, must be performed with judgment, and gradually, as any sudden removal of a large number of the inferior ones would have the effect of ruining the whole. In endeavouring to recover the better trees of a neglected plantation, therefore, so as to preserve them for ornamental effect, the smaller ones proposed to be removed for relieving them must be taken out gradually, and not all at once. By attention to this I have seen the crop of neglected hardwooded plantations very much improved; but much of the success always depends upon the selection that is made of the trees for standing, before thinning commences; as, if weakly-rooted trees are left, with comparatively heavy tops, they never succeed, but become still more weakly after the inferior trees are removed.

1103. A plantation of trees managed on the principle of allowing every one in it to stand clear of and unencumbered by any of its neighbours at all stages of its growth, always becomes more valuable as a crop, is more ornamental, and lives to a greater age, than one managed differently. This is a fact based on the laws which regulate the vegetable kingdom, which we are daily in the habit of observing, and yet which most proprietors of plantations do not seem to take advantage of; otherwise we would not see so many worthless plantations as we do at the present day. In illustration of the point I may ask, why it is that trees found standing alone on parks grow on for even two and three hundred years in a healthy condition, while those in crowded plantations become matured and die at a very early stage.

The answer is clear; in the case of the former class the trees had full room to extend their roots and branches in order to keep good their health; whereas, in that of the latter, the roots became diseased and weakly at an early stage from want of food, and their branches were smothered, and therefore failed to act for the maintenance and support of the trees.

SECTION II.—MANAGEMENT OF PINE AND FIR PLANTATIONS OF CONSIDERABLE AGE, REARED CHIEFLY WITH A VIEW TO ORNAMENTAL EFFECT.

1104. If masses of pine and fir are generally objected to in the immediate neighbourhood of the seats of landed proprietors, from their too dark and sombre effect, they are not, in any undulating and hilly district, objected to when grown on the tops and higher slopes of the back-ground, as on such sites they, from their producing a clothed and massy appearance at all seasons, give the landscape such a grand effect as is not attainable by the presence of hardwooded sorts alone; and from this we generally find plantations of pine and fir, on extensive properties, cultivated with a view to their being kept up as ornamental, independent of the timber they produce.

1105. In training up plantations of these sorts, whether mixed or separately, with the view of their standing for ornamental effect, the trees should, at all stages of their growth, be kept somewhat farther apart from one another than when trained up for the sake of their timber alone; and this in order that they may develop themselves in their natural and true habits, both in regard to stems and tops. In doing this, however, they need not be kept so far apart as to cause the specimens to become of a rough and branchy habit, but only to such a degree as to insure their not being drawn up; and this state of the trees is generally secured by keeping them at distances from one another as nearly as possible equal to one half their average height, as has been already recommended in reference to the distance apart in the training of the hardwooded sorts for ornamental effect.

1106. If pine and fir plantations are trained up in this way till they have attained upwards of fifty years' growth, they will require very little attention in the way of thinning afterwards, as the trees will, by the time they have arrived at this stage, have become generally well developed specimens, and will therefore only require to be relieved by times, as a few of the superior specimens may want more space for the greater spread of their tops, or as a portion of the inferior ones may show a tendency to encumber the better. This will be found all that is necessary for promoting the healthy maturity of pine and fir plantations after such an age as is now supposed; provided, of course, that the trees have been properly trained.

1107. Where such plantations as I am speaking of—pine and fir upwards of fifty years of age—have been neglected while young, and have been drawn up and the trees rendered weakly in consequence, there is little hope of their recovery by any system of management afterwards; but of course, in reference to this, as well as in the parallel case of the hardwooded sorts, the recovery will be in degree according to the extent of the neglect. Still, from experience, I find that equal degrees of neglect in hardwooded plantations, and in pine and fir ones, are attended with very unequal degrees of recovery to improvement afterwards. The crop of a hardwooded plantation, although it has been much neglected, will improve wonderfully if skill be applied to the thinning of it, while that of a plantation of pine or fir of the same age, and equally neglected, will not only not improve at all, but will, on the contrary, go back the more quickly when thinning is attempted. Therefore, when it is found desirable to improve a neglected pine or fir plantation, more judgment is necessary for success in the work than in the case of a hardwooded one.

1108. To improve a neglected plantation of coniferous trees, the same mode of thinning should be followed in regard to it that has been recommended for the recovery of neglected hardwooded plantations, and as detailed in paragraph 1102. When, however, the trees left do not seem to improve under the operation of thinning, in two or three years after it has been commenced, the better mode is to clear them altogether, and to replant.

1109. The spruce and silver firs, as well as the larch, are more easily injured by confinement than any of the pine tribe I am acquainted with, and this in degree according to the nature of the soil and site they occupy. In a dry and open subsoil the pine maintains its health for a long time, although grown in a crowded state, and on such a soil it recovers wonderfully, when judiciously thinned after long neglect, while on a soil of an opposite character it can scarcely be improved at all in such circumstances. The spruce fir and the larch, if neglected to be thinned when grown on a light soil with a dry bottom, soon become unhealthy, and heart-rot succeeds; while, on the other hand, they will keep very much longer in a healthy and growing state, under the same degree of neglect, when grown on a heavier soil with somewhat of a cold bottom. I make these remarks in order that the inexperienced forester may be the better enabled to judge as to how far the different species referred to are likely to improve after neglect, according to the nature of the land they occupy; for, after all, very much of the success attending the thinning of neglected plantations of any sort, will be found to depend upon whether the land is naturally well suited to the trees or the contrary.

SECTION III.—MANAGEMENT OF HARDWOODED PLANTATIONS OF CONSIDERABLE AGE, REARED WITH A VIEW TO SALEABLE TIMBER ALONE.

1110. In the first place, it is worth noticing in reference to the difference betwixt the rearing of hardwooded trees with an especial view to ornamental purposes, and that of the same sorts with the view of their becoming timber for sale only, that in the case of the latter, less space is necessary for each tree grown, as large tops and branches are not so much the object of the cultivator as the quantity of available timber in the stem, and, therefore, a larger number can be reared on a given extent of land.

1111. A plantation of any sort of hardwooded trees, if it have been dealt with, up to the age of nearly sixty years, in the way that has been described in a former section of this book, will require very little attention from the forester, other than removing from time to time any inferior trees, as such encroach upon others of a more promising and valuable description.

1112. In the management of plantations consisting of mixed sorts of hardwoods, all of considerable age, the forester will have to see that the more spreading branched sorts, such as the ash and the elm, do not interfere with the full development of the oak in particular, which is more easily injured by such encumberers than almost any other tree.

1113. Although, generally speaking, a greater number of trees may be properly grown upon a given extent of land, when intended to be cleared as a crop of timber, than when intended for permanent ornamental purposes, still, great caution and judgment are necessary to be exercised in this respect by the cultivator, as, if the crop should be allowed to become crowded, a very great loss of timber would be the result; because, under such circumstances, the trees would be drawn up weakly, and consequently would become pre-matured. This, then, must be guarded against, as, in fact, much of the value of the crop ultimately depends upon whether the trees are allowed sufficient space to develop themselves healthily. The only sensible rule that can be given for guidance in this respect is to allow each tree sufficient space for the healthy action of its branches and leaves, but not to such an extent as to encourage the spread of the branches at the expense of the stem.

1114. A great encouragement to the healthy growth of all trees in masses is to keep the land in a dry and wholesome condition; and this is highly promoted by the drainage of all wet parts in the first place, and by keeping all drains at all times in a clean and thoroughly operative state. Without attention to this on land naturally wet, the trees are sure to become diseased in their roots, prematurely old, and, therefore, worthless in the quality of their timber.

SECTION IV.—MANAGEMENT OF PINE AND FIR PLANTATIONS OF CONSIDERABLE AGE, REARED WITH A VIEW TO A CROP OF TIMBER ONLY.

1115. The most valuable description of pine timber is that which is most free from branch knots, and of the greatest diameter and length of stem. To secure these points, it is found necessary, in the cultivation of the trees for timber, to keep them standing at such distance apart from one another as is found conducive to check the too luxuriant growth of branches, without injuring their healthy action, and thereby throw the greater tendency of the sap to the formation of timber in the stems. Much as it is desirable to attain these qualities in respect to the pine, great caution is necessary to be used in its cultivation, as most foresters are more apt to grow the trees in too crowded a state, and thereby deteriorate the crop both in quantity and quality.

1116. In the management of pine plantations of upwards of fifty years' growth—keeping in view what has just been stated as desirable points in their cultivation for the sake of timber, and supposing that they have been generally well attended to previously—there will be found very little to attend to other than the removal, from time to time, of such inferior trees as are found to encumber more promising ones, as by the time the trees have attained the age referred to, they will be nearly all of confirmed habits of growth, indicating their result when at maturity.

1117. If the plantation of pine trees is large, and the land favourable to their rapid and healthy growth, there is a great tendency of the crop to become crowded and drawn up; the shelter of the mass being conducive to this state. When this is the case, the regular and systematic courses of thinning should be carefully continued to a later stage than would be necessary under a contrary state of the crop; the forester, therefore, should attend to this, and see that at all stages, while the trees continue to make considerable progress, they are not allowed to become crowded, or to interfere with the healthy action of the branches of one another; and especially if the plantation is large, attention to this is requisite.

1118. To show that it is desirable to grow pine plantations on the principle of judiciously checking the growth of the branches of the trees, in order to induce the finer quality of timber in the stems, I may state that, taking any two trees of equal dimensions, the one of the rough and branchy habit of growth, and the other of the contrary, the timber of the former would be at least of one-third less value than that of the latter; thus making a vast difference on the value of a plantation of considerable extent.

1119. I stated in a former section that the branches of the fir are not naturally disposed to grow so strong as to interfere with, or affect the quality of, the timber—unless, indeed, the trees are allowed to stand so far apart as to be uninfluenced by each other's shelter; in which case they do become somewhat rough, from the excessively strong branches they produce: and that, if the full and healthy development of their branches is prevented, the health of the trees is impaired in consequence. This point, then, must be kept in view at all stages of the cultivation of the fir, and all that is necessary to secure the full health of a crop of these trees, when grown on a suitable soil, is to thin in such a way as to keep the branches of each tree from encumbering those of its neighbours. We find very few plantations of fir any where cultivated on the principle here set forth, and the result is that for the greater part, by the time they have arrived at the stage I am referring to—from fifty to sixty years—they are drawn up, diseased, and worthless as a crop, either for ornament or for use as timber. From this, it is generally considered that the fir lives only from sixty to seventy years in a healthy condition. I could, however, prove the contrary, as we have cut healthy, sound, and growing firs upwards of ninety years of age, and this was where the land was well suited to them, and where they had stood at all stages free and unencumbered, and clothed with branches nearly from bottom to top. Where, therefore, it is desirable to cultivate fir trees to the greatest possible value, and so as to stand healthy as long as possible, the points I have stated must be attended to.

1120. The larch also requires full space for the spread of its branches, in order to grow it to perfection. In fact, few trees are more easily injured than the larch by confinement; therefore, at all stages the trees should be allowed ample space for the spread of their branches, as from inattention to this point many plantations have been rendered comparatively worthless that might, had they been dealt with as I here suggest, have been of very great value to their proprietors. In making these remarks, I do not of course mean that the trees should be allowed to stand far apart from one another, in order to insure their branches being kept healthy. Such a course would result in a great loss of crop on the land occupied. I only mean that the trees should not be kept so close as to interfere with the healthy action of the branches of each other. This state of the trees is easily attainable under skilful management in regard to systematic thinning while comparatively young, and by judicious attention to relieve the crop of inferior encumberers after the trees have attained considerable age, and till they approach maturity.

SECTION V.—SUGGESTIONS IN REGARD TO HOW THE MATURITY OF TREES MAY BE KNOWN, AND AS TO HOW THE MATURED CROPS OF PLANTATIONS GENERALLY SHOULD BE DEALT WITH.

1121. A crop of trees, as well as of grain, should be disposed of by the proprietor as soon as it becomes matured, and before it deteriorate in value. I state this generally, however, and not as applicable to the crops of plantations exclusively reared for ornamental purposes, but to such as have been planted and reared for the sake of their timber; which may be said in regard to most woods not specially preserved for effect in the neighbourhood of home grounds.

1122. That a plantation of timber trees should be disposed of to the best advantage after it has become matured is generally admitted and acted upon by landed proprietors, but very often without judgment, and therefore to their own loss. In explanation of this, I may only state that I have frequently seen the crops of healthy plantations, which were increasing annually in value, sold and cut down, because they had attained a certain age, and because from this they were considered matured; while, on the other hand, I have as frequently seen plantations left standing, although they had been deteriorating in value for many years, because it was considered they could not be matured, not having attained the usual age that the species in ordinary cases takes to arrive at maturity. At this stage of my remarks the questions arise, When do trees usually arrive at maturity? And, How is it to be known when they have arrived at this stage? I shall endeavour to answer these questions.

1123. No age can be given as that at which any kind of tree arrives at maturity, as all depends upon the condition of the soil in which they grow, and upon the nature of the treatment they may have received collectively. I have seen the ash, and other hardwooded trees, quite matured when only about seventy years of age, while I have also seen them in a healthy progressive state at one hundred and twenty years. In the former case, the trees grew upon a light soil, and stood in a crowded condition from neglect of thinning; in the latter, they grew upon a heavy loam, had been well attended to in the way of thinning, and from this their health and vigour had been maintained. I have seen the larch matured under thirty years of age, because it grew on a wet, and therefore uncongenial condition of soil;

while on the other hand, I have seen it in a healthy and still growing state although upwards of one hundred years of age; but in this case the trees grew on a sloping bank of good land, and had free space for the spread of their branches. With regard to the Scots pine, although all the land in Strathspey may be said to be naturally well adapted to the healthy growth of this tree, still, we have it matured at all stages betwixt fifty and two hundred years, according as the crops have had space for healthy development. In some of the plantations which were made some fifty years ago, and which had been utterly neglected to be thinned, the crops are now so matured that we have decided upon clearing them, as the most advantageous mode of dealing with them. In others, which were planted upwards of eighty years ago, but which had been partially attended to and thinned, we find the trees generally matured, but not yet losing in value; while on many parts of our natural forests, where the trees have stood rather open, and quite apart from others, they are quite healthy, although upwards of two hundred years old. These facts, then, go to prove that maturity in any plantation depends partly upon the nature of the soil, but still more upon the management they may have been trained up under. In short, management in the training up of a plantation is everything in respect to its becoming matured early or otherwise, as well as in respect to its ultimate value; for, generally speaking, the longer that a plantation continues to grow, the more likely is it to become of great value, and the more judiciously it is thinned the more surely will this result be brought about.

1124. From the foregoing remarks, then, it is to be inferred that the maturity of a crop of trees is not to be judged by the length of time they may have grown, and that the continuance of the healthy action and increase of bulk to a great age in trees depends upon the nature and condition of the soil in which they stand, and even more so upon whether they have been well managed in regard to thinning. Some other criterion than age must therefore be laid down for our guidance in regard to the maturity of the crop of a plantation, and this we have no difficulty in applying with an infallible degree of security.

1125. All trees, while in a healthy and growing condition, throw out shoots at the points of their branches, and lay on their stems a quantity of new woody matter every year successively, proportionate to the species and to the stage of their existence, as well as proportionate to the nature of the soil and situation on which they grow. Trees, generally speaking, make the strongest annual shoots while under fifty years of age; after this stage the growths gradually lessen in length, till maturity approaches, when they all but cease to lengthen; and it is from this condition of the annual shoots that the maturity of trees may be known.

1126. In examining a plantation, then, with the view of ascertaining, whether its crop is still making progress sufficient to warrant its being kept growing, or so matured that its being cleared is necessary in order to realise the highest possible value for it, the first point is to examine the general progress the shoots have made for some six years previously, and if it is found that the average of the lengths does not exceed from two to three inches annually, it is a strong proof that the trees are matured, and that they cannot possibly increase in bulk to such an extent as to make good the interest on their present value. If, however, after an examination of this sort, it be found that the annual shoots have averaged from four to six inches in length, with proportionate strength, during the six previous years, it would be premature to fell the trees, as such a length of the growths is an indication that they are still making such an annual addition to their value as to justify their being kept growing for some years longer. Another point should be attended to in examining a crop of trees with the view of learning whether they are matured or not, and that is the state of the foliage. On all trees in a healthy condition, and making considerable progress in growth, the leaves are large—according to species—fresh, and plentifully distributed on the young shoots; while, on such as are matured, and therefore may be said to be comparatively unhealthy, they are small, not well developed, and thinly distributed. There is still another point worthy of remark on this subject. It is this: the leading, or top shoot of the stem of a tree, invariably makes considerable annual progress upwards, so long as the tree itself continues in a healthy and growing condition, but as soon as the tree begins to fail in vigour and become matured, the top shoot fails to make progress, and from this the tree becomes gradually flat-topped, and of a broad-headed character. This last feature is more particularly observable in the pine family, and is to be accounted for from the fact that as the tree loses vigour, its vitality fails to send its sap sufficiently up to enable it to make wood on the highest part, and it is therefore confined chiefly to the formation of woody matter on the lower branches, so that the top and higher branches of a tree always indicate the state of the subject in regard to maturity before the lower parts do.

1127. From these characteristics of the state of trees as they present themselves, whether as healthy and growing, or as matured, I think any intelligent man may be able readily to distinguish trees in the one condition or in the other. I ought here to remark, however, that notwithstanding there is at all times a great loss sustained by the proprietor who cuts his timber trees before they are matured, as in such a case the crop is adding to its value every year, still, on the other hand, there is as great a loss sustained by the one who does not cut it till it is over-matured, as in this case the timber is much inferior in quality from being over ripe, and consequently the purchaser will take care to give him a price for it accordingly; so that the most satisfactory course for all parties concerned is to decide upon disposing of a crop of trees before it becomes so matured as to make the quality of the timber doubtful. It is perhaps not generally known or understood, that as soon as trees have arrived at the stage of maturity indicated by extremely short growths of young wood, and by a very spare clothing of foliage, their timber is in a state of slow decomposition, not, perhaps, observable to the inexperienced eye, although it is to one accustomed to examine it with a magnifying power. So that this advanced stage of the trees should never be allowed to present itself where sound timber is an object, and where the highest possible price for a crop of it is expected.

1128. A satisfactory examination having been made of a crop of trees, I shall suppose that it has been found that portions of it have been found matured, but not over much so, here and there; that other portions are so matured as to be deteriorating in value; and that on several parts it is still making considerable progress. Now these features, in regard to a crop of trees, will be found in all plantations of any considerable extent, whatever the kind of tree may be, as in no enclosure do the trees all grow alike, and arrive at maturity at the same time; very much depending upon the nature of different portions of the soil, and upon the difference of aspect, &c. &c. In such a case, therefore, we should at once conclude, that although a portion, even to the extent of nearly one-half the crop, were in such a state as to justify its being kept for a time, still, from the fact of the other half being partly quite matured, and partly over matured, there is the probability of a much greater loss by allowing the matured trees to remain till the others were so, than could possibly be made up by the increase of their growth, so that no hesitation should be entertained to cut the whole. It may indeed be argued that it would be better in such a case to dispose of the matured portions, and to leave the growing portions to improve. This, at the first glance, seems indeed reasonable, and in the case of hedgerow and park trees would be sound practice; but in the case of trees forming a plantation collectively, the result would be the contrary of good management; as, were the matured portions cleared, and the portions which were making progress left, the latter would be sure to become impaired in health and stunted immediately when they were exposed by the removal of the other trees from them; so that the best policy, in all such cases, is to decide at once on clearing the whole crop. I recommend this from my own experience in dealing with the clearing of such plantations, and I do so from a full conviction of this mode being the most profitable in the end.

SECTION VI.—RULES AND REGULATIONS NECESSARY TO BE OBSERVED IN THE CUTTING DOWN AND SELLING OF TREES, WHETHER AS THINNINGS OR CLEARINGS OF OLD TIMBER.

1129. The cutting down and disposing of timber forming, as it were, the harvest of forest operations, and much of the value of that harvest depending upon the manner in which it is done, it is of very great importance that the principles upon which it ought to be conducted should be well understood.

1130. There are two ways of disposing of timber — viz. by PUBLIC ROUP and by PRIVATE BARGAIN, both of which ways may be put into practice, upon any given place, according to local circumstances, to profitable account; but, generally speaking, where there is a large quantity of timber to dispose of at once, and more especially when it is of a mixed character, the greatest amount of money will be realised by the proprietor when he disposes of it by public roup. At public roups, there are in all cases people collected who are in quest of various sorts of wood, from the smallest size to the largest, consequently a competition takes place among them, which generally brings each lot to its value before being sold. As to the manner of conducting public and private sales of wood, I shall here give my own method of procedure, beginning first with the selling of wood by public roup.

1131. We shall presume then, in the first place, that the timber to be disposed of consists of thinnings of various sizes, as to be taken from plantations of several different ages, and of different kinds of wood; and also presuming that the work of cutting is to be LET by contract, the trees, of course, having been previously marked by an experienced forester. I beg it to be understood here, that I do not mean to say that the cutting of all trees should be let by contract, for where there is an experienced forester upon an estate of moderate size, it is not necessary to do so; but where there does not happen to be such, or where the woods are of such an extent as to justify this mode, I find it necessary to have the cutting of wood let; and in such cases I bind the contracting party to do the work in the manner and according to the rules laid down in the following form of specification:—

1132. SPECIFICATION of Work to be done in the cutting down and preparing Timber for Public Sale, on the Estate of D——e, November 1860.

Article 1. The trees to be cut for public sale are marked with white paint, and will be pointed out to the contractor by A B, residing at the East Lodge, D——e.

Art. 2. All the trees marked in the park must be cut down with the cross-cut saw. In the young plantations the trees marked may be cut down with the axe, excepting those that are *at and above* six inches diameter at the ground, all which must also be cut down with the cross-cut saw.

Art. 3. Each tree, previous to being cut over with the saw, must be *laid in* with the axe to the level of the surface of the ground, and then cross-cut to that level.

Art. 4. Any damage done to the standing trees by the falling of the others, or otherwise, shall be charged against the contractor at the rate of double the market value of each tree injured; and any damage done to the trees taken down by the careless work of the people employed, shall also be charged against the contractor at a rate equal to the deterioration in value caused by such damage.

Art. 5. Each tree, as it is cut down, must be neatly pruned from all side branches, and the bole laid entire along the side of the road, in order for sale—no cross-cutting of the bole being allowed.

Art. 6. The side branches, as they are taken from the trees, must be arranged into lots in order for sale, to the satisfaction of the above named A B, or any person named by the proprietor.

Art. 7. All implements, as well as horses, &c., that may be required for the performing of the work, to be furnished by the contractor.

Art. 8. The oak trees marked are not to be cut down till the usual time of peeling in the summer, nor under the present agreement.

Art. 9. All the trees marked, excepting the oak, to be cut down and arranged into lots for sale, in the manner as detailed above, for the sum of three shillings per pound sterling of the amount of roup-roll, and to be finished and in readiness for sale on or before the 26th day of December next.

Art. 10. All disputes or differences that may arise as to the due execution and fulfilment of the foregoing articles, shall be referred to the determination of Mr J. O., forester at M——h, whose decision thereon shall be final.

The above form requires to be signed by the contractor and witnesses in the usual manner.

1133. By going to work in the way above specified, I have had many plantations thinned and the wood prepared for sale, and that in a very efficient manner; of course always employing a person who could do the work well, and who had been accustomed to work of the same kind before.

The person having the oversight should see that each sort is arranged into separate lots by itself; and no individual lot should contain less timber than twenty-five cubic feet, in order that there may be a cartload for the purchaser; and each individual tree should be pruned out to the full length.

1134. I have often had occasion to observe at sales of timber, that where large trees had been cross-cut to a particular length for the sake of convenience in having them removed from the interior of the wood to the side of the nearest road, they never sold nearly so well as others of the same dimensions and quality which had been left entire. The reason is, that purchasers of timber, when they have it in long lengths, can always apply it to many more purposes than they can do short lengths; therefore this is a point that should be strictly attended to in the preparing of wood for sale, because the value of trees may be much deteriorated by injudicious shortening of their boles.

1135. All timber of good quality should be lotted separately from that of indifferent quality. Let good timber be sold in lots by itself, and inferior timber in the same manner; and if possible, whatever number of cut trees may be put into a lot, let them be nearly of an equal size. The great advantages arising from such a system of arranging the wood into equal sizes and qualities, will appear evident when I say, that if a purchaser come to a sale of wood with the view of buying, say one lot of good small ash for handle-wood, and found the kind he wished to purchase mixed up with other inferior trees in the same lot, he might of course buy the lot in which he saw a few trees suitable for his purpose, but he would reckon nothing upon the value of the inferior trees sold along with them, he having of course no use for such; and the same may be said of any other sorts mixed up in a careless manner. But where each sort is arranged according to its particular use and quality, the full value of each may be readily got from different people who may have a use for the different sorts.

1136. When trees are laid together in the way of lotting out for sale, the bottoms and tops should all be laid one way, and that in a regular manner, so that the purchasers may see at a glance the size and quality of the wood they may wish to purchase.

1137. All lots of wood prepared for public sale should be carried out of the plantations, and put upon the sides of the nearest roads, for the convenience of purchasers getting to them with their carts; which arrangement is always in favour of the wood bringing a high price.

1138. After the wood has been all lotted in the manner advised above, each lot should be numbered and entered to a corresponding number in a book made out for the purpose; at the same time stating the kind of wood that each lot consists of, with the number of trees in each, and the medium value of the same. In order to illustrate this sort of book, as used by me, I shall here give a statement from my own, as taken from a sale of wood which we had at Arniston. Such a statement, I am aware, will prove interesting and useful, both to proprietors and young foresters who may wish to have information on the point.

1139. WOOD LOTTED AND NUMBERED FOR SALE AT ARNISTON, 15th November 1850.

Number on each Lot.	Number of Trees in each Lot.	Kinds of Timber in each Lot.	Names of Purchasers.	Forester's Valuation.			Value as sold at Sale.		
				£	s.	d.	£	s.	d.
1	5	Oak	John Philip, Bonnyrig	0	15	0	0	14	0
2	3	Do.	Do.	0	18	0	0	16	0
3	3	Do.	Do.	1	0	0	1	4	0
4	6	Do.	Do.	1	0	0	0	17	0
5	2	Do.	Robert Grindlay, Roseberry	1	6	0	1	10	0
6	7	Ash	Do.	0	12	0	0	13	0
7	11	Elm	Mr Coldwells, Gorebridge	0	13	0	0	13	6
8	1	Larch	John Philip	0	18	0	1	2	0
9	1	Ash	Mr Galbraith, Edinburgh	1	1	0	1	4	0
10	1	Do.	Do.	2	10	0	3	0	0
11	0	Firewood	Mr Dalgleish, Gilmerton	0	3	0	0	3	6
12	0	Do.	Do.	0	4	0	0	3	9
13	1	Elm	Thomas Johnson, Temple	1	8	0	1	15	0
14	1	Plane	John Philip	2	10	0	2	15	0
15	1	Do.	John Carrick, Glasgow	7	10	0	8	12	6
16	1	Larch	John Philip	2	15	0	3	0	0
17	1	Do.	Do.	3	15	0	4	5	0
18	1	Ash	Mr Galbraith	8	15	0	12	0	0
19	1	Beech	Mr Easton	2	0	0	1	15	0
20	8	Spruce fir	John Philip	1	4	0	1	0	0
21	7	Beech	Mr Coldwells	0	10	0	0	6	0
				41	7	0	47	9	3

The foregoing statement, taken from my note-book, will at once point out how I am in the habit of arranging and conducting sales of wood made by public roup.

The first three columns of the statement given, with my own valuation, are all filled up previous to the day of sale; and upon the day of sale I follow the auctioneer, and fill up the other two columns which were left blank; that is, I then enter the purchasers' names opposite each lot, and the price given; and as the clerk of the sale keeps also an account of the same, my book forms a check upon him in case of any mistake occurring; and, besides, such a book kept by the forester becomes a guide both to himself and the proprietor, for the purpose of ascertaining if the wood sell at a fair price or not.

1140. Relative to public sales of wood, it yet remains for me to state how they should be advertised and made known to the public; and this should be always done about two weeks previous to the day of sale, so that time may be given for its being properly made known. The following is the form of intimation which I made regarding the sale which we had at Arniston, just referred to. Its insertion may prove useful here to other foresters who may have occasion to give intimation of the same kind for their wood sales:—

SALE OF WOOD.

There will be sold by Public Roup,
ON THE ESTATE OF ARNISTON,
Near Fushie Bridge,
On Friday the 15th November,

A large quantity of Timber, consisting of Sycamore, Ash, Larch, and Beech, of large dimensions; a considerable quantity of Oak adapted for trams, spokes, and other country purposes; Ash for handle-wood; Larch, Scotch Pine, and Spruce Fir, fit for deals, roofing, &c.

The above will be exposed in lots to suit purchasers. The Sale will begin at Braidwood Bridge, under Temple Village, exactly at ten o'clock forenoon.

T. D., *Auctioneer.*

ARNISTON, 31*st October* 1850.

1141. In order that such an intimation may be made properly public, it should be inserted in two or more of the local newspapers, and printed forms put up along the public thoroughfares, and sent to people who are known to be in the habit of buying wood.

1142. We shall now suppose that all the wood intended for sale has been cut and arranged in the manner advised above, and that due intimation has been given relative to the same; particularly observing to make a fair statement of the kinds of wood to be sold. The next important point the forester will have to attend to is, the articles and conditions of sale. The following is the form by which, upon the estate of Arniston, we were in the habit of exposing our wood to public sale:—

ARTICLES and CONDITIONS of SALE of WOOD on the Estate of ARNISTON, to be exposed for Sale on this 15th day of November 1850.

Art. 1. The wood to be put up in lots, and at such upset prices as the company may think fit, and sold to the highest bidder, who shall be bound to implement the following conditions:—

Art. 2. Each lot to be at the entire risk of the purchaser thereof as soon as called down by the auctioneer; but none of the lots to be interfered with until a settlement for the same be made to the satisfaction of the exposer, his agent, and judge of the roup.

Art. 3. The exposer reserves one bode on each lot for his own behoof, and also power to adjourn the sale if he shall see cause.

Art. 4. Any damage done to the plantations, gates, or fences, in the removal of the wood from the ground or otherwise, shall be paid for by the purchaser against whom such loss or damage can be qualified, the master being always accountable for his servant.

Art. 5. Purchasers shall be allowed six weeks from the day of sale to remove their purchases from the ground; and should any purchaser fail in having his purchases removed by the time above specified, he shall forfeit his offer of purchase, and be liable to the exposer in one-fifth part of his offer of purchase in name of penalty; and the exposer shall have it in his power to do with each lot or lots as he may think proper for his own benefit. The first offerer, notwithstanding, shall remain bound for the original price.

Art. 6. Purchasers, if required, shall pay to the clerk of sale one-fifth of the price of each lot as a deposit.

Art. 7. All sums at and below ten pounds sterling to be paid ready money; and for all sums above ten pounds, three months' credit will be allowed on bill and caution being granted to the satisfaction of the exposer, his agent, and judge of the roup. Purchasers paying ready money shall be allowed sixpence per pound on all sums above five pounds.

Art. 8. A person duly authorised to point out the lots and receive payment of the same shall be in attendance every lawful day between the hours of seven o'clock morning and five o'clock evening during the time before specified.

Art. 9. Purchasers to meet with the exposer's agent and judge of the roup on Wednesday the 20th next, between the hours of twelve and two o'clock, in the White Hart Inn, Grassmarket, Edinburgh, and the Cross Keys Inn, Dalkeith, on Thursday following, at the same hours, to settle for their purchases. Those, however, wishing to settle immediately after the sale will be accommodated.

Art. 10. Purchasers to pay the bill stamps their respective sums may require.

Art. 11. T. D. is hereby appointed judge of the roup, with full power to settle all differences that may arise between the purchaser and exposer, or between the purchasers themselves; and his decision shall be binding, without the power of appeal to any court of law.

In witness whereof,

(Signed) ____________

1143. What I have stated in the foregoing part of this section is only applicable, properly speaking, to the sale of wood on a comparatively small scale, and which has been cut; but it is frequently found desirable and necessary to expose wood in a growing or standing state, and that on a large scale also. In such a case, the business requires to be gone about very minutely and carefully in all its branches, as a heavy responsibility attaches itself to the forester if anything go wrong in the result,—I mean in respect to money matters,—and from this it is necessary that he provide himself with every precaution against fraud. For the information of foresters generally, I shall here give a sketch of how I proceed with our sales of timber in Strathspey, and also copies of our forms of bargain with our purchasers. Having determined upon selling the timber on a certain district, we advertise it after the following manner, in some six of the most influential newspapers, and that for three consecutive weeks before the day of sale :—

1144.

SALE OF TIMBER
IN THE FOREST OF ABERNETHY, STRATHSPEY.

There will be exposed to sale by Public Roup, on Friday the 27th current,
Within the COURT-HOUSE, Grantown,
At Eleven o'clock forenoon,

20,000 Standing Trees of Larch and Scots Pine, fit for railway sleepers, boards, &c. The trees are divided into ten different lots of various sizes to suit purchasers.

J. T., forester on the district, will point out the lots previous to the day of sale; and further particulars may be learned on application to J. B., Wood-manager to the Earl of Seafield, Grantown.

GRANTOWN, *4th March* 1860.

1145. Previous to issuing such an advertisement, however, we have the trees intended for sale all marked and numbered, keeping each lot separately, so that all the trees in each can be properly distinguished from those of the other. The way we do this is: we begin our marking upon one side of the district purposed to be cleared, and continue successively from side to side, till we have the number of trees marked we desire to embrace in the first lot; when we commence the second lot alongside of it, taking care to make the marks of the trees of the second lot upon the opposite sides of the trees from those of the first, and so on with all the other lots, keeping all the marks of any lot upon one side, and reversing them alternately for each lot.

1146. We mark every tree in each lot, and enter its value in a book, so that we are perfectly prepared on the day of sale to state the number of trees in each lot, and to know as the sale goes on whether we are offered full value for each as it is put up.

1147. Our mode of marking the trees is this: we begin with lot No. 1; a man with an axe takes a slice from the side of the tree we intend to number on, and he makes it deep enough to take the bark clean off, with a thin slice of the outer wood. This done, another man follows with a piece of *red keel*, and marks on that part of the tree from which the slice was taken, thus $\frac{1}{1}$. The man with the axe proceeds to the second tree and removes a similar slice from it, when the man who follows him with the keel marks on it thus, $\frac{2}{1}$; and on the third tree $\frac{3}{1}$, and so on with all the trees in the lot. When they have finished the marking and numbering of he trees in the first lot, they proceed to the second, of course taking care o mark the trees of it on the opposite sides from those of the first, and naking the marks thus—$\frac{1}{2}$, $\frac{2}{2}$, $\frac{3}{2}$, and so on with each lot as the numbers ise. The meaning of this mode of numbering is this: $\frac{1}{1}$ represents the irst tree of the first lot, $\frac{2}{1}$ the second, $\frac{3}{1}$ the third, and so on with all the trees of the first lot, so that the last tree of the first lot might be $\frac{2000}{1}$, which means the tree numbering 2000 of the first lot. So with the numbers on the other lots; $\frac{1}{2}$ means the first tree of the second lot, $\frac{2}{2}$ the second; and in the same way all the trees of each lot are successively numbered, each in the order of its lot, so that the intending purchasers can see at any time they examine the lots the number of trees in them; all this obviates trouble afterwards. Again, while the men are thus engaged in marking and numbering the trees, the forester follows them and notes down their contents and value respectively; so that by the mode here described any quantity of trees may be easily marked, valued, and disposed of with a great degree of correctness, and in the most satisfactory manner.

1148. Having got the trees all marked, numbered, lotted, and in every respect prepared for sale in the way described, we next get our conditions of sale drawn up; and as these form a most important branch of the business of selling wood by public auction, I shall here, for the benefit of foresters, give a copy of the form we are in the habit of using for such sales. This form is as follows, always prepared and drawn out on stamped paper before the sale commences:

1149. ARTICLES and CONDITIONS of ROUP and SALE of LARCH and PINE TIMBER in the FOREST of ABERNETHY, Strathspey, the property of the Right Honourable the Earl of Seafield. To be exposed to sale by Public Roup, at sight and instance of James Brown, Wood-manager to the said Earl of Seafield, within the Court-House of Grantown, this Twenty-seventh day of March Eighteen hundred and sixty, at Eleven o'clock forenoon.

Article 1. The said timber will be exposed to sale by public roup in ten different lots, or in one or more lots, and during such space of time as the judge of sale herein-after named may determine, at a certain upset price per lot; and the person offering the said upset price, and in case of more offerers than one, the highest offerer shall be preferred to the purchase.

Art. 2. In case several offers shall be made for any lot or lots so put up, every subsequent offer shall be at least one pound sterling more than the preceding offer when under fifty pounds, two pounds when above fifty pounds and under one hundred pounds, and five pounds when above one hundred pounds; and each offerer shall subscribe his offer, if required by the judge of sale, and become bound for the sum offered by him in terms and upon the Conditions of these Articles.

Art. 3. The person preferred to the purchase of any lot or lots shall have right thereto after paying or otherwise settling for the same in terms of these articles, and the purchase money shall be paid to the said James Brown, as exposer foresaid, in manner following: The purchaser shall pay down into the hands of the clerk of sale herein-after named, one-third part of the purchase money in part payment of each lot, within fourteen days from the date of sale, which third part shall bear legal interest thereafter till paid; and grant bills for the balance of price with security, to the satisfaction of the exposer and judge of this sale, payable in Grantown, by equal instalments, at four and eight months from the date of sale. Acceptors of bills to pay the stamps; and no part of the timber will, on any pretence whatever, be permitted to be interfered with or taken into possession by purchasers until paid in cash, or otherwise duly settled for agreeably to these articles; all within the said space of fourteen days from the date of sale.

Art. 4. For all cash payments in full, discount at the rate of five per cent per annum will be allowed if paid within the said space of fourteen days.

Art. 5. The timber shall be felled, manufactured, and removed at the sole expense of the purchaser before the thirtieth day of May Eighteen hundred and sixty-one; but in the event of any one purchaser buying the whole of the timber exposed for sale, such purchaser shall be allowed two years from the date of sale to clear and carry away his purchase from the forest—the proprietor, the said Earl of Seafield, his heirs and executors, always retaining and reserving to himself and his foresaids a right of lien or hypothec prior and preferable to all other parties whatever over the timber sold in the forest until the purchasers' bills or purchase prices are duly paid; and any person failing to clear the forest of his purchases within the time prescribed, shall forfeit and lose whatever timber belonging to him may be found in the forest after the expiry of the time allowed for removal, and the same shall revert and return to the said Earl of Seafield, or his foresaids, to be used or disposed of by him or them at pleasure. Purchasers will be allowed to erect saw-pits, saw-mills, and other accommodation for manufacturing their timber, in such places as the surveyor shall allow.

Art. 6. Purchasers are hereby taken bound to keep at all times clear of obstructions the roads and accesses to and in the forest, and not to do any injury to any tree or trees reserved from sale within any lot, or to those on any other portion of the forest; and no purchaser shall be permitted, on any pretence whatever, without the written permission of the surveyor of the forest, to light fires within the forest except for steam machinery; and in the event of the reserved trees being in the least damaged or destroyed by the purchasers or those in their employment, the purchaser shall be bound to take the whole of the trees so damaged at the rate of five shillings sterling per cubic foot, according to the forester's measurement.

Art. 7. The lots, after the sale, shall be at the sole risk of the respective purchasers thereof; but no lot shall be taken possession of by the purchaser without written authority under the hands of the surveyor of the forest; and any person presuming to interfere with the lots, directly or by means of any other person or persons, without such written authority, shall be considered a wilful trespasser, and prosecuted as law directs.

Art. 8. The trees constituting each lot are carefully, and believed to be correctly, numbered and described, and the purchasers are to take the same as numbered and described in the roup-roll appended to these articles, without being entitled to any compensation or abatement from the price offered and accepted, by reason or on account of any deficiency or mistake, alleged or real, in number, quantity, quality, or description, it being understood that parties have satisfied themselves as to these considerations previous to the day of sale.

Art. 9. Any purchaser failing to pay the said third part of the value of his purchases, and to grant a bill of security as aforesaid therefor, shall, in the option of the judge of this sale, not only forfeit his interest in and right to the purchase, but shall be liable to the exposer in one-fifth part of the price offered by him, in name of liquidate damages, which shall in no event be modified; and it shall be optional to the exposer either to hold the said purchases himself, or to re-expose the same to sale, or to declare the same to belong to the immediately preceding offerer; and in case intimation of such failure shall be made to the immediately preceding offerer within the space of seven days next after the expiry of the fourteen days mentioned in article number third of these conditions, he shall be deemed and held to be the purchaser, and shall be obliged, within six days after such intimation, to make payment of one-third part, and grant security as aforesaid for the price offered by him, under the like penalty of forfeiture ; and so forth, the whole course of offerers, until these articles and conditions are implemented and fulfilled.

Art. 10. In the event of there being no competition, or no one offering the upset price for any lot or lots put up to sale, power is hereby reserved to the judge of the sale to reduce the said upset price, and again to expose the said lot or lots to public roup, at such upset price, and under such alterations or modifications of these conditions as he may think fit.

Art. 11. The exposer reserves to himself one offer on each lot previous to being struck out by the auctioneer of the sale.

Art. 12. John Grant, licensed auctioneer, residing in Grantown, is hereby appointed auctioneer of this sale ; J. C., residing at D——, near Grantown, clerk thereto, and the said John Grant is appointed judge thereof, with power to adjourn the same from time to time in regard to part or the whole of the timber, and with or without such adjournment, to reduce the upset price, to alter or modify these articles and conditions, and to determine all questions or disputes that may arise in connection with this sale, between the exposer and the offerers or purchasers, or amongst the offerers themselves relative to the premises in any manner of way; and the said Earl of Seafield, by the subscription of these presents on his behalf, and the offerers by subscribing their offers on the roup-roll, are hereby taken bound respectively to fulfil the articles and conditions to each other under the penalty of two hundred pounds sterling, to be paid by the party failing to the party performing or willing to perform the same, over and above performance; and both parties consent to the registration hereof, and of the roup-roll or minute of roup, decerniture of the judge, and minute or minutes of enactment, in the Books of Council and Session, or others competent, therein to remain for preservation; and if necessary, that letters of horning on six days' charge, and all execution needful, may pass on a decree to be interponed hereto in common form, and thereto constitute

their procurators, &c. In witness whereof, these presents consisting of this and the two preceding pages of stamped paper, written by J. B., clerk to A. B., Writer in Grantown, are subscribed by the said James Brown on behalf of the said Earl of Seafield, at Grantown, the twenty-seventh day of March Eighteen hundred and sixty years, before these witnesses, David Grant, clerk to the said A. B., and Robert Smith, clerk to the said James Brown.

(Signed) James Brown,
For the Earl of Seafield.

D. Grant, *Witness.*
R. Smith, *Witness.*

1150. In drawing out such a document, it must be kept specially in view to have this done on a sheet of stamped paper of sufficient value to carry the amount of the sale, as, if this should not be attended to, any legal prosecution afterwards could not be maintained. Of course the different conditions herein set forth can always be modified to suit the views of parties, and to suit the nature of the timber to be disposed of. Besides such articles and conditions of sale as the foregoing, previous to the proposed sale, it will be necessary to have prepared and appended another document, which is referred to in the articles and conditions, and is called the Roup-Roll. This is merely an abstract account of the several lots, and the result of them after the sale. The following is a copy of the form of roup-roll we use, and attach to our conditions of sale, and this must be attached and in readiness, along with the conditions, before the sale commences.

1151. ROUP-ROLL of PINE and LARCH TIMBER, in the FOREST of ABERNETHY, sold within the Court-House, Grantown, 27th March 1860.

No. of Lots.	Description of Trees.	Number of Trees in each Lot.	Names and Residences of Purchasers.	How Settled.	Price.	Sums paid.
1	Scots pine	2000	Colin Archibald, Aberdeen, *Eight hundred pounds.* (Signed) C. Archibald.	One-third paid, and remainder settled by bill.	£800 0 0	£266 13 4
2	...	1500	P. Grant, Grantown, *Six hundred pounds.* (Signed) P. Grant.	do.	600 0 0	200 0 0
3	...	1000	J. Robertson, Grantown, *Four hundred pounds.* (Signed) J. Robertson.	do.	400 0 0	133 6 8
4	...	3200	John Yule, Newburgh, *One thousand four hundred pounds.* (Signed) J. Yule.	do.	1400 0 0	466 13 4
5	...	4300	R. Urquhart, Forres, *One thousand six hundred pounds.* (Signed) R. Urquhart.	do.	1600 0 0	533 6 8
6	...	800	J. M'Pherson, Dunkeld, *Three hundred pounds.*	do.	300 0 0	100 0 0
7	...	2500	R. Nicholson, Newcastle, *One thousand five hundred pounds.* (Signed) R. Nicholson.	do.	1500 0 0	500 0 0
8	...	1200	J. M'Kenzie, Perth, *Four hundred pounds.* (Signed) J. M'Kenzie.	do.	400 0 0	133 6 8
9	Larch.	1500	A. Oswald, Perth, *Nine hundred pounds.* (Signed) A. Oswald.	do.	900 0 0	300 0 0
10	...	2000	John Yule, Newburgh, *One thousand five hundred pounds.* (Signed) J. Yule.	do.	1500 0 0	500 0 0
		20,000	Total amount of Sale, ...		£9400 0 0	
			Paid on day of Sale, ...			£3133 6 8

1152. In conducting such an extensive sale as is represented by the foregoing copy of roup-roll, it is necessary to have a clerk constantly engaged while the sale goes on, in taking down the names and residences of every one who gives an offer for any lot, as, if this is not attended to, the exposer cannot fall back upon the bidders for the respective lots—as provided for in the articles and conditions—in the case of the parties to whom they were sold failing to implement the conditions of payment. It is not, indeed, often that parties fail to make good payment according to the conditions stipulated; but as it does sometimes happen, and we have experienced it ourselves, it is necessary to be prepared for the worst; and by taking a note of every offer given for each lot at the sale, the exposer can always fall back upon them to make good their offers, if required.

1153. In extensive transactions of this kind, the exposer should cause every purchaser of a lot to subscribe it as it is knocked down to him; this prevents misunderstandings afterwards, and lays a strong hold on the buyer to fulfil his bargain; and what is perhaps better for the proprietor of the timber, it gives him a legal hold upon the purchaser that he could not otherwise have.

1154. In the same manner as shown in the preceding section, any sorts of trees may be given intimation of and sold. Oak and other coppice woods are generally sold by the acre, or they may be sold in lots to any certain or convenient extent, mentioning about the number of acres in each lot, which should be all valued previous to the day of sale: such sales of coppice may be made in the month of April or May.

1155. Having said thus much relative to public sales of wood, it yet remains for me to refer to the conducting of wood sales by private bargain.

In the selling of timber by private bargain, it is generally done at a certain rate per cubic foot, according to kind and quality; or it may be done at so much per tree, or so much for a certain number of trees; and in this case the trees are, of course, valued by the forester previous to making his bargain with the purchaser. In some cases where I have had a quantity of timber to dispose of, and which was to sell by private bargain, I have taken private offers for the same from different parties who were inclined to have it, and, of course, sold to the person who gave the highest price for the whole.

In a transaction of the kind, however, especially when it is to a considerable extent, and involving some risk, it is necessary to have a proper form of agreement drawn out on stamped paper, and signed by the parties, as without such an agreement, even although the price should be paid in advance, misunderstandings are apt to arise, which very often lead to lawsuits. Where, however, proper written conditions of agreement are attended to in such matters, both parties get on pleasantly, from having such a document to refer to. As an example of an agreement for wood sold by private bargain, I shall give a copy of one made the other day with a party who bought 20,000 trees from a property I had to do with. Such a document I have no doubt will be higly useful in enabling foresters to adopt such a mode of procedure in their dealing with parties privately for sales of wood. The following is the copy of agreement referred to:—

1156. CONTRACT of SALE betwixt A. B., for Sir J. R., and J. R. & W. M., Timber Merchants, E——d.

It is contracted, agreed, and ended, betwixt A. B., residing at R——e, near G——n, wood-manager to, and for behoof of, Sir J. R., and duly authorised in the premises, on the one part, and J. R. & W. M., timber-merchants at E——d, on the other part, in manner following:—That is to say, the said parties, considering that the said J. R. & W. M. have offered to the said A. B., acting for the said Sir J. R., the proprietor, for twenty thousand Scots pine trees, standing in the forest of R——n, partly on R——n Braes, and partly on the west side of Tor Hill, all as already marked off and pointed out, the total sum of two thousand nine hundred and eighty pounds and fourteen shillings sterling, which offer the said A. B., acting foresaid, has accepted upon the terms and subject to the conditions hereinafter set forth; and as it is necessary to enter into a contract of sale containing the usual and necessary clauses, therefore the said parties have contracted and agreed as follows:—

Article 1. The said twenty thousand trees shall be, by the district forester, made into lots of various sizes, and for the first lot, containing seven thousand nine hundred and twenty-eight trees, the said J. R. & W. M. bind and oblige themselves to pay at the rate of five shillings and sixpence for each tree; for the second lot, containing two thousand three hundred and forty-four trees, at the rate of five shillings per tree; for the third lot, containing eight thousand and thirty trees, at the rate of sixpence per tree; and for the fourth and last lot, containing one thousand six hundred and ninety-eight trees, at the rate of twopence per tree; the aggregate price of which several lots amounts to the foresaid sum of two thousand nine hundred and eighty pounds and fourteen shillings sterling.

Art. 2. The said J. R. & W. M. bind and oblige themselves forthwith, and before they have right in any way to interfere with any part of said twenty thousand trees, to pay to the said A. B., for behoof foresaid, the sum of nine hundred and ninety-three pounds eleven shillings and fourpence sterling, being one-third part of the purchase price of said timber; and grant bill with security to the satisfaction of the said A. B., for remaining two-thirds, payable in G——n, by two equal instalments, at six and twelve months from the date of these presents.

Art. 3. It is contracted and agreed that the purchasers shall have, from the date of these presents, three years to remove their purchase from the lands of the forest; and they bind and oblige themselves, and their heirs and successors, to remove the said timber by such roads and accesses as shall be pointed out by the said A. B., or the district forester; and further, the said J. R. & W. M. bind and oblige themselves, during said period of three years, to keep clear of all obstructions the roads and accesses to and from and in the forest, to be used by them; and to pay one-half the sum required for making new roads for their exclusive use, and a like proportion of the sum necessary for repairing roads made to be used by them.

Art. 4. It is contracted and agreed that the said J. R. & W. M. shall have a site for a saw-mill on the farm of R——n, where pointed out; and they bind and oblige themselves and foresaids to remove from said mill and mill site, at the first term of Whitsunday, after the expiration of said period of three years, and that without any summons of removing or process whatever.

Art. 5. The said J. R. & W. M. bind and oblige themselves and their foresaids to pay for any damage done by them or their servants to timber, standing or lying, in or near to the forest, not forming part of their purchase, double the value of such timber, and the same shall, notwithstanding such payment, remain the property of the original owner; and the said J. R. & W. M. further bind and oblige themselves not to interfere with, or break down, any part of the forest enclosures in the course of their operations, without the sanction of the district forester, and then, upon such conditions as shall be stipulated by him.

Art. 6. It is contracted and agreed that the said J. R. & W. M. shall be responsible for damage done by fires, kindled within the forest, by themselves or their servants, without the sanction of the forester.

Art. 7. It is specially contracted and agreed that the said Sir J. R. and his foresaids shall, during the currency of the bill to be granted for two-thirds of the purchase hereby made, as before provided, have a right of lien or hypothec over any part of said purchase on or near to the lands of the forest, prior and preferable to all other creditors of the purchasers; and it is further agreed that should the purchasers fail in the observance of any of the conditions stipulated by this contract, it shall be in the option of the said A. B., or Sir J. R.'s wood-manager for the time, upon such failure, either to permit this contract to remain obligatory, or to declare it at an end, and forthwith to eject and remove the purchasers and their foresaids, and all others acting in their name, from the lands of the forest, and from said mill site, and to enter upon possession of the same, and that without any declarator or process whatever; and it is hereby declared that the purchasers shall be held to have failed in their said obligations, in the event that they shall not duly pay the instalments of the price falling due under the bill to be granted as before provided; and,

Lastly. Both parties, the said A. B., for Sir J. R., and the said J. R. & W. M. bind and oblige themselves to implement this contract to each other under a penalty of two hundred pounds sterling, to be paid by the party failing to perform to the party performing, or willing to perform, over and above performance; and both parties consent to the registration hereof in the books of Council and Session, or other Judge's books competent, therein to remain for preservation, and that all necessary execution, on six days' charge, may pass upon a decree to be interponed hereto in form as effeirs, and to that effect they constitute
their procurators, &c. In witness whereof, these presents, written on this and the three preceding pages by A. B., Writer in G———, are subscribed as follows—viz. by the said A. B., at G——n, the eighteenth day of March Eighteen hundred and sixty years, before these witnesses, the said A. B., the writer hereof, and H. B., his clerk, and by the said J. R. and W. M., at E———d, the twenty-third day of March, year last mentioned, before these witnesses. A. H., banker, W———l, and A. M., accountant there.

(Signed) A. B.
A. B., *Witness.* („) J. R.
H. B., *Witness.* („) W. M.
A. H., *Witness.*
A. M., *Witness.*

With an agreement after the foregoing form, containing all necessary clauses and conditions, any sale may be made by private contract, on equally as sure grounds as if the sale had been made under the conditions provided for a public sale. Having given this form at full length, we think it unnecessary to comment upon it, as it speaks for itself; and as it can be altered to suit the use of any description of sale, whether large or small, of whatever kind of trees, or under any peculiarity of circumstances.

1157. The foregoing statements are applicable only to wood as it is sold in the round or rough state; but the selling of wood by private bargain, when cut up into various scantlings at saw-mills, is very different, and sometimes a matter of considerable difficulty to young foresters. Therefore, for their assistance, I shall here give a few statements, showing how they may be able to calculate the fair value of timber, of any scantling, as they may have occasion to sell it from saw-mills under their charge.

1158. We shall suppose that a forester is in the habit of getting 1s. 2d. per cubic foot for his larch timber, as sold lying in the plantations in the round state, and that he has charge of a saw-mill, at which he wishes to cut up his larch for sale to various sorts of scantlings as may be required. We shall further suppose that he wishes to learn at what rate he should sell the cubic foot of sawn timber, so as to have at least the same profit to the proprietor off the cut timber that he is in the habit of realising from the round. In order to illustrate this point in as clear a manner as possible, we shall suppose that the forester has lying cut, in one of the plantations under his charge—say one mile distant from the saw-mill—one hundred and fifty cubic feet of larch timber, which he values at 1s. 2d. per cubic foot, or at £8, 15s. for the lot, being the sum he could realise for it in the forest, independent of any further trouble. The question now is—At what rate per cubic foot should this larch be sold, after being carted from the woods and cut up at the mill, so as to realise the original price, and cover all necessary expenses? The following statement will form an answer to the question:—

To two horses and carts, drawing one hundred and fifty feet of larch from the woods, one mile distant from the saw-mill, at 5s. per day for each horse,	£0	10	0
To one man assisting in loading carts, at 2s.,	0	2	0
To four men in saw-mill one day, cutting up the same into scantling 6 × 2 inches, at 2s. 6d. per day each,	0	10	0
To keeping up machinery of mill, files for saws, oil, &c., &c., &c.,	0	15	0
	£1	17	0

Here, now, we have the outlay necessary for converting the hundred and fifty feet of rough wood into scantling at the saw-mill—namely, £1, 17s. —being 3d. additional upon the cubic foot nearly; therefore, in order to realise the original sum of 1s. 2d. per foot for the proprietor, the forester will require to lay on 3d. extra on each foot of the sawn wood, making it 1s. 5d. per foot to the buyer of the wood from the mill.

1159. In order to illustrate this case still farther, we shall suppose that a house carpenter comes to the forester, and inquires at what rate *per lineal foot* he could supply the above larch scantling—namely, six inches by two inches, for roofing purposes, and to be laid down at a distance of four miles from the saw-mill. Here, again, the forester will require to consider how much extra per cubic foot it will take to lay the wood down at a distance of four miles from the saw-mill. We reckon that thirty feet of sawn timber is a fair load for a horse; and, at four miles distant, a horse will take two loads in a day—that is, a horse will draw from the mill sixty feet in one day to a distance of four miles. Therefore, calculating 5s. a-day for a man with a horse, we have sixty feet of timber laid down for 5s., making 1d. extra on the foot—that is to say, the forester could lay the scantling down, at four miles distance from the saw-mill, at 1s. 6d. per cubic foot, and still have the 1s. 2d. clear for the proprietor. The forester having now, we shall suppose, ascertained the price per cubic foot at which he could lay down the sawn timber to the carpenter, his next point of inquiry is, and which the carpenter desires to be made aware of, at what rate per lineal foot he could give the scantling. My method of calculation, in a case of this nature, is as follows:—

	In. In.	
The square of the end of the scantling,	6 × 2 = 12)	144
Number of lineal feet required to make one foot cube,		12

Here we have the square of the scantling, which is 12, exactly 12 times out of 144; thus showing that, of a scantling 6 × 2 inches, 12 feet in length are required to make one cubic foot of timber, therefore these 12 lineal feet can be sold at 1s. 6d., or at 1½d. per lineal foot, which is the answer required.

1160. As every forester should be well acquainted with the sort of calculations now under notice, I will here give another statement of a different scantling from the last.

We shall suppose that a forester gets an order from a party for a quantity of paling rails, say 4 × 1 inch, to be Scots pine. We will say that the forester sells his Scots pine, of the size adapted for paling, at 8d. per cubic foot in the rough state; and that he reckons that, to bring the wood in to the mill and saw it up, will cost him 4d. extra per foot, as in the former case. Here, then, the price of the sawn wood will be 1s. per cubic foot; and the forester wishes to ascertain at what rate he can sell the paling rails, per yard of three feet lineal measure. In order to ascertain this, he has to calculate thus :—

In. In.
The square of the end of the scantling, 4 × 1 = 4) 144
Number of lineal feet required to make one foot cube, 36

That is, it requires 36 feet in length of a scantling, 4 × 1, to make a cubic foot of wood ; and in 36 feet in length there are, of course, 12 yards ; therefore, if 12 yards in length cost 1s., the forester is enabled to sell the paling rails at 1d. per yard, and still have 8d. per foot cube for the proprietor as the value of his timber.

1161. Knowing that calculations of this nature are extremely useful to all denomiuations of foresters, I shall, before concluding this section, give yet another example, showing how to calculate the value of deals per square foot, according to the rule formerly given. Suppose that a forester is requested to supply deals of one inch in thickness to a party from his saw-mill—say from old Scots pine timber, and that the deals must be at least twelve inches broad. In this case, we shall suppose that the forester values his Scots pine at 1s. 2d. per foot lying in the woods in the rough state ; then he must add to this the expense of mill-work and cartage, as in the former cases, at 4d. per foot ; and say that he can supply the sawn wood at 1s. 6d. per foot cube, his next point of inquiry will be, at what rate he should sell this wood per square foot when sawn into deals of one inch thickness ?

It was said that the deals were to be twelve inches in breadth; therefore the calculation will again be thus :—

In. In.
Square of thickness and breadth, . 12 × 1 = 12) 144
Number of lineal feet required to make one foot cube, 12

Here, again, we find that it takes twelve superficial feet of boards to make one cubic foot of timber ; which, again, is reckoned in value at 1s. 6d. ; therefore, the forester can supply the boards one inch thick at 1½d. per square foot. Having given the above statements, it would be superfluous to give any more upon a matter so very simple, as the rule is the same in all cases, whatever be the size of the scantling, and whatever may be the price of the wood per cubic foot.

1162. In conclusion, I may here add, that unless a forester be well acquainted with the above rule for calculating the value of cut wood, he cannot be able to sell it by private bargain to parties who may be inquiring after it. Where wood is cut up at saw-mills, people will come inquiring after scantlings of every size and kind of timber ; and if the man who has the charge be not able to give a clear and definite answer to builders and others about the value of wood, who may wish to deal with him, they will at once consider him a person of inferior capabilities; and, in such a case, many will be ready to take the advantage, and try to secure a bargain for themselves at the cost of the forester's character and the proprietor's purse.

SECTION VII.—REARING AND MANAGEMENT OF PLANTATIONS FOR A SUPPLY OF HOP-POLES.

1163. Poles for supporting hops in hop-fields are procured from various sources; partly from coppice-shoots, partly from thinnings of young plantations reared with a view to timber, and partly from crops of various sorts of trees planted and reared expressly for the purpose; and in all cases the price varies according as the wood of which they are made is of a description calculated to last a long or a short time, and also in proportion to the size or length of the poles.

1164. Shoots of oak, sweet chestnut, sycamore, and ash, are all used for the purpose when they are found of suitable lengths in coppice woods; but the poles of such sorts being of a soft and comparatively perishable nature, do not bring such a high price in the market as those of larch, which lasts very much longer. Even Scots pine is used for this purpose, but the larch is preferred to any other wood in most cases.

1165. As larch, from its durability, when young, is found to give the most profitable description of hop-poles, in rearing plantations exclusively for the purpose, no other tree should be planted, as it always, when well grown, brings the highest price in the market for this purpose.

1166. There are two modes of growing the larch for hop-poles. One is, to plant the young trees at distances varying from eighteen to thirty inches apart, according to the size of poles wanted, and to let them grow undisturbed till they are of the size wished, and then they are cut all over and disposed of at once. The other mode is, to plant the young trees at eighteen inches apart, and when they have arrived at a stage suitable for the smaller size of poles, to thin out each alternate tree, and leave the others to grow for some years, until they are fit for the larger sizes. Either of these modes may be adopted, according to the class of poles that may be found most in demand in the locality. In Woolmer forest and its neighbourhood, large quantities of young larch are reared for this purpose, and they are there planted, some fields at eighteen inches apart, others at twenty inches, others at twenty-four inches, others at thirty inches, and others at about three feet apart,—all depending upon the character of the poles it is wished to grow, whether of a small size or of a large one; of course the smaller the poles are wanted the closer the trees are planted.

1167. There is no class of tree crop more simple of cultivation than this, as the only point aimed at is that of obtaining the largest quantity of clean, straight poles, from a given piece of land, and this is attained by planting the young trees closely, in order that they may draw up one another to the desired length.

1168. It is often found desirable to rear several crops of this sort in succession on the same piece of land, and where this is an object with the cultivator, it is requisite that the land should be trenched at the outset, as by doing this the young trees will grow more rapidly, and therefore be fit for the market some two, or even three years earlier than if they had been planted on uncultivated land; and of course from this a great advantage is gained, both in point of time, and in that of the smaller amount to pay as the rent of land occupied by the crop. In preparing the same piece of land for a second crop of hop-poles, it should be trenched—and all the roots taken out in the operation—some eighteen inches deep, so as to bring up new land and bury the old surface, which had grown the first crop. This done, a green crop should be taken from it after manuring, when it will be again in a state properly fitted to grow a second crop of poles, which, from being planted on manured land, will grow rapidly, and repay any outlay in this respect. This may be done successively, one crop after another, for any reasonable length of time, as it is not timber that is wanted, but mere poles from ten to twenty feet in length.

1169. On light, sandy, and poor thin land, in the south of England, I have seen Scots pine successfully grown for hop-poles. This was on land which would not produce larch in a healthy state to sufficient size for the purpose, being mere sand and gravel, and yet, upon it, the Scots pine grew well, and paid the proprietor amply, although a smaller price is given for pine poles than for larch. In fact, the poorest land possible may be converted into profitable bearing by rearing the pine on it for this purpose, as it is not necessary they should be grown to a size larger than three inches diameter.

CHAPTER IX.

SECTION I.—MANAGEMENT OF GENERAL COPPICE PLANTATIONS.

1170. The raising of coppice plantations is, of all others, the most simple, and requires the least practical knowledge in the forester. Excepting oak coppice, this sort of forest cropping is seldom cultivated in Scotland; whereas in England it is very much cultivated, and forms in many counties the principal crop grown in the form of wood. This is the more necessary, particularly in those inland counties where all kinds of fuel are scarce; there, where neither coal nor turf can be easily got, the inhabitants must resort to wood as a substitute; and, in such cases, all small rubbish in the form of wood becomes of importance.

1171. In many parts of England, all hedge prunings and small twigs from the branches of larger trees are carefully gathered up and disposed of in the form of fagots for firewood; while, on the other hand, in Scotland and in the north of England, where coal and turf abound, such small wood is considered useless, and is invariably burned up as mere rubbish. As, therefore, the growing of wood in the form of coppice is necessary in many parts of Britain, I shall devote the present section to a few remarks as to the best mode of growing the greatest possible quantity of coppice upon a given space of ground in a given time.

1172. All coppice plantations must, in the first instance, be raised from young trees. The young trees, when planted for this purpose, ought to stand till they are from five to six inches diameter at the ground: this may be, according to the kind of trees planted, and according to the soil and situation upon which they are growing, at from fifteen to twenty years of age. In order to convert a plantation of young trees into coppice, it is only necessary, when they have arrived at the stage mentioned, to cut them over by the surface of the ground, when, in the following season, they will send up from each *stock* a number of young shoots, these constituting what is termed coppice-wood.

1173. All trees do not equally possess the property of sending up young shoots from the collar of the stock; therefore, the choice of the kind of trees is to be taken into consideration by the grower of coppice-wood. The fir and pine tribes do not send up shoots at all when cut over, and the beech does it but slightly. The kinds of trees best adapted for coppice plantations are, the ash, elm, oak, poplar, willow, chestnut, lime-tree, mountain ash, maple, sycamore, birch, alder, hazel, and bird-cherry. These again, according to the uses they are generally applied to, may be divided into four classes—namely, first, *Coopers' ware and bobbin-wood*—ash, elm, oak, chestnut, maple, hazel, and sycamore. Second, *Charcoal wood*—birch, alder, poplar, lime-tree, and mountain ash. Third, *Bark for tanners*—oak. Fourth, *Basket-ware*—the willow. In the above division of the kinds of trees best suited for coppice, I have not included firewood, because all the sorts may be employed for that purpose, although not with like effect—the ash and birch being more useful than any of the other sorts; but as, in general cases, it is only the refuse of the coppice which is applied to the purpose of firewood, it is unnecessary to designate a class exclusively for that purpose. I may also state that, although I have mentioned mountain ash as being adapted for charcoal, it is one of the best also for coopers' ware; and although I have included hazel among those adapted for coopers' ware, it is also excellently adapted for charcoal. Similar differences of application might also be stated relative to several others of the trees. In what remains of this section I shall point out the best method for the cultivating of each division, so as to produce the greatest possible crop upon the ground.

1174. In laying out a plantation with the intention of its becoming coppice, it is necessary to take into consideration what sorts of coppice-wood will sell to the best advantage in the neighbourhood; and having determined this point, the next consideration will be, whether or not the ground to be planted is of a nature qualified to produce the kind which is in demand. This I would particularly draw attention to; for to plant those kinds of trees which are not adapted to the soil, although it should be well known that they would sell well when of size, would be the most effectual way of defeating the end in view. For example, were ash, elm, limetree, or poplar, planted upon a dry thin soil, with the view of becoming profitable as coppice—or, on the other hand, hazel, mountain ash, or birch, in a cold, damp, heavy soil—disappointment would assuredly be the result.

1175. Having fixed upon the situation upon which trees are to be planted for coppice, have it laid off, fenced, and drained, in the same manner as has already been advised for other plantations where it is in view to raise large timber.

1176. We shall suppose that a plantation of five hundred acres in extent is laid out for this purpose, and that it consists of various hilly tracts, with a thin, poor, yet dry soil, with also considerable portions of good loamy soil, and in the hollows, mossy parts, which have been effectually drained of all superfluous moisture;—we shall further suppose that all sorts of coppice-wood sell to advantage in the country in which this plantation is situated; —and by this means we will have the advantage of illustrating the whole system within the bounds of the one plantation.

1177. *First*, then—In all the bare hilly parts, the soil of which is light, and not more than a few inches deep, plant, at seven feet apart, birch, mountain ash, and hazel, and make up between them with larch or Scots pine, to three and a half feet over all. The latter are to act as nurses for a time, in order that the plants which are intended for the future coppice may grow up the more rapidly, and come the sooner into use.

1178. *Second*, Upon all the hilly parts which are less elevated than the first, the soil of which may be from eight to ten inches deep, plant maple, sycamore, oak, and chestnut, at about eight feet apart, and make up between them with larch to four feet over all.

1179. *Third*, In all the portions of good loamy soil, having an elevation less than either of the two former tracts, plant ash, elm, lime-tree, poplar, and oak, at from eight to ten feet apart, and fill up with larch to three and a half or four feet over all, according to the distance of the hardwood plants.

1180. In planting the different sorts of trees in the different soils and situations above stated, each sort should be planted in a mass by itself, and by no means mixed, as is too often the case, to the great disadvantage of the crop in general. The latter system is the cause that, in general coppice plantations, where the kinds of trees have been promiscuously mixed in the first planting, we so often find so light a crop of the whole per acre upon the ground at the end of a given period. For example—were mountain ash, birch, and hazel, all mixed together in a coppice-wood, the mountain ash, from being a more rapid and luxuriant growing plant than either of the others, would very much retard their growth, and hinder the development they naturally would attain under different circumstances. This I have very frequently had occasion to observe; and from the experience that I have had upon this point, I may state further that, were three acres planted with a mixture of the above three sorts, and other three planted each with one of the sorts separately, the latter would have, at the end of a given period, one third more weight of wood upon it than the former. Trees are like animals: they, as it were, like to associate each with its own kind; and this is also observable in natural forests. There the best timber of any sort is always found where one sort prevails; while, on the contrary, where a mixture exists in the natural forests, few good specimens of any individual sort are to be found; and the very same holds good in most cases in the artificial forests of our own country. Many plantations are to be seen where several sorts of trees are mixed and come to full age; and in such cases it is invariably found that one sort has an ascendancy over all the rest, both as to healthy appearance and general magnitude. I have seen numerous examples of the same thing holding good in coppice-wood plantations; and any proprietor or forester who may doubt what I assert here, has only to examine his own plantations, and he will there see its truth exemplified. In all cases, therefore, each sort of tree, which is meant to stand as a permanent crop, should be planted in a mass by itself, and that to such an extent upon the ground as may be considered necessary. When coppice plantations are conducted on the principle of growing each sort of tree in a mass, another important point is gained, namely, that of each sort answering a certain purpose better than another at a given period, and therefore each division will be found the more valuable to any purchaser who may wish to buy coppice of a certain kind and size. For example, were a man to come to a proprietor of coppice plantations, and say that he wished a certain quantity of hoop-wood for the market, of a particular size, and if the purchaser saw twenty acres of hazel all of the proper size for his purpose, would he not give double the sum for it per acre, seeing it was so equal, which he would do for other twenty acres of a mixed character, from which, very likely, he could not get one-half of the wood to answer his purpose? The same may be said of oak coppice: a person might give a good sum per acre for oak coppice in a mass, while, if he found it mixed with other sorts for which he had not much use at the time, he might give comparatively little.

1181. In planting the permanent trees, let the greatest extent be given to such sorts of hardwood as are known to be most valuable and most sought after in the market, in so far as the nature of the ground may be qualified to bring them to perfection; and at the same time, with regard to the nurses which are planted for the purpose of producing a temporary shelter, let very few of them be of the evergreen sorts, such as Scots pines, or spruce firs, but give the preference to the larch, because it is of a light and airy habit, and not apt to draw up the hardwood trees as the more massy branches of the others are known to do. It is a bad feature in the management of young trees intended for coppice when they are drawn up tall and without proportionable girth. In converting young trees into coppice, it is most desirable to allow them to attain as much diameter at the *collar*, or that part of the stem situated nearest the ground, as possible; therefore, with a view to this end, the plants ought by all means to be sheltered so as to make them grow rapidly, but by no means so much as to draw them up. Were the hardwood plants allowed to grow without the benefit of nurses, they would be some years longer in coming into use as coppice; and besides, the spaces between them would be profitless to the proprietor; but when nurses are planted among the permanent hardwood, besides bringing them forward, they are of considerable value when cut down and sold as thinnings.

1182. In high exposed parts, where the hardwood plants are likely to suffer from the effects of storm, about one-third of the whole number of the nurses per acre may be Scots pine; in less exposed parts one-fourth; and where the ground is generally of a sheltered nature, the whole of the nurses may be larch.

1183. In portions of the plantation having a good deep loamy soil, with rather a sheltered situation, or at least with the prospect of being well sheltered as the other parts of the plantation rise up, osier coppice may be made; but unless the soil be of a good deep loam, with considerable shelter, it will be in vain to expect a good crop of osiers from it. In laying down a piece of ground for the cultivation of osiers or willows, it is indispensably necessary that the ground be trenched to the depth of thirty or thirty-six inches; and before planting the willows upon it, it should have a good manuring, and be cleaned by a crop of turnips or potatoes being taken off it. When the ground has been thus trenched and cleaned, the next step is to plant the willows in rows from thirty to forty-eight inches apart, according to the kind to be cultivated; the plants themselves being from twelve to eighteen inches distant in the row, according as the sort cultivated may be of a small or large character; for there are many varieties in cultivation for basket-making, hoops, &c.

1184. The willow plants must at all times be kept clean from weeds, and the ground dug regularly in the autumn or spring, or at least after the crop has been cut and removed. If this keeping of the plants clean be not attended to, the yearly weight of the crop, instead of increasing as it ought to do, will be found to decrease, as I have frequently seen to ensue where they were under bad management. No nurses are planted among this sort of coppice; for, the ground having to be dug between the rows of the plants, these could not exist.

1185. In any hollow or mossy part of the plantation, where, from the dull inert nature of the soil, the other sorts of hardwood would not succeed well, have alders or birch put in, from six to eight feet apart, according as the natural situation may be exposed or not. If exposed, have the ground between made up with Scots pines; but unless the ground have been thoroughly dried, the Scots pines will not succeed in such a soil.

If charcoal do not sell well in the neighbourhood, ash, or even poplar, will succeed very well in a mossy soil; but, in the present instance, and for the sake of illustration, we shall suppose alder or birch to be the tree that is to be planted.

1186. Having premised the above, relative to the disposal of the trees upon these different soils and situations, we shall now follow out the management which should be adopted during the growth of the trees to the period at which they are in a state for cutting over for coppice, and also state the manner of disposing of the crop as it comes to full age.

In rearing up a plantation of young trees for coppice, the forester must in this case, as well as in that of rearing up trees for timber, carefully guard against the hardwood plants, in particular, being choked by long grass, or any rank growths of weeds, during the first three years of their age: he must also be careful, as they advance, to have all nurses taken away as their branches approach those of the hardwood. In this case never allow the branches of the nurses even to lie upon the points of those of the hardwood plants; for if they are at all allowed to encroach, the latter will very likely be drawn up rather weakly, and, consequently, will not grow proportionally to diameter of trunk—the great point required in order to make a valuable coppice plantation.

1187. Having attended very carefully to keep the nurses duly off the hardwood plants, and having merely allowed them to stand by and give shelter to them for a time, the nurses will, by the time the plantation is from fifteen to twenty years old, have been all removed from the ground, and at the same period—viz. from fifteen to twenty, or even twenty-five years, according to soil and situation—the hardwood plants will be from five to six inches diameter at the bottom, but not of a tall habit, having intentionally been kept in a rather exposed state. When they have attained this size, they will then be in a proper condition for cutting over for the purpose of being converted into coppice *stocks.* I am aware that, in the cultivation of general coppice plantations, many are in the habit of cutting over the young trees at a much earlier period than that mentioned above; but such a system of management is decidedly injurious to the future bulk of the crop, and tends to weaken the stocks rather than to strengthen them. I am decidedly of opinion—and my opinion is the result of experience—that in moderately sheltered situations, the trees should not be cut over until they are as nearly as possible six inches diameter at the bottom: if cut over of a smaller size, the future crop will be proportionally lighter and weaker. By allowing the young trees to attain the size of from five to six inches at the base before cutting over, they will afterwards send up strong and healthy shoots, while these will also be numerous; but if cut over of a much smaller size, the shoots will be few in number, and proportionally weak.

1188. Having fixed upon the time or period at which the young trees in a plantation should be cut down as a preparation for future coppice-wood, the next thing to take into consideration is the proper manner of doing the work.

Fig. 130.

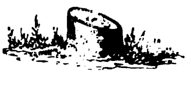


Fig. 131.

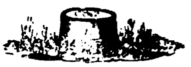
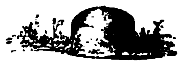


Fig. 132.



Several methods are in practice among foresters. Some cut them down with the axe, and leave the stocks in the sloping form represented in Fig. 130, this sloping position of the stock being meant to throw the water off it, and prevent rot from taking place. I object to this method, because, in the cutting over of a young tree by repeated strokes from an axe, the stock is much damaged, and apt to be split longitudinally; consequently, rot is sure to commence early. Fig. 131 represents another method frequently practised, which is, to cut over the tree by means of the saw, leaving the stock flat on the top. I object to this method also; because, when they are cut over in this manner, from the circumstance of the stock being flat on the top, rain is sure to lodge upon it, and cause rot at an early age. Fig. 132 represents the form in which all stocks should be made which are meant to keep sound, and produce a healthy crop of coppice, and is that which is employed by all superior foresters. The following is the method of procedure:—

1189. Have a young lad with a sickle, such as is used for cutting down grain, and cause him to go before the men who are to cut the trees, and clear away all long grass, &c., from the base of each tree to be cut. This he should do to the distance of about two feet all round each tree; and in doing this, he must be made to cut the grass as short as possible, in order that there may be no obstacle to having the trees cut low. When the boy has got the first tree cleared at the base, two men with a light cross-cutting saw follow him. The saw should first enter upon one side of the base of the tree, which, of course, should be the side to which the tree is intended to fall; and having cut at least two inches through upon that side, and about two inches up on the base of the tree from the ground, they then take out the saw, and cut the tree through from the opposite side.

My reason for not cutting the tree through with the saw from one side is, that when this happens to be done—and it is too often done—and when the tree has just begun to fall, the bark upon the side of the tree opposite to where the saw was entered, is liable to be torn away, with very often a part of the outer wood; and this will the more readily occur if there be a little wind blowing at the time; this almost invariably taking place before the men have time to cut the part clean through. Now, this evil can at once be avoided, by simply cutting, in the first place, a part of the base upon the side to which the tree is to fall. In this manner the boy, with the two men following, will prepare and cut down the trees, observing to cut each stock so that it may be, as nearly as possible, about two inches high above the surface of the ground. Next in order, there will be required another man with an axe, whose duty is to prune the branches from each tree as it is felled; and the branches, again, as they are cut off, are to be assorted for different purposes, according to the local demand. These are, in general, fence-wood, ton-wood, fuel, besom-sprey, &c.; and the branches, as they are cut off and assorted, should be carried out to the nearest road in the plantation, and laid in convenient lots, each according to its kind, in order for sale: this sort of work can, in most cases, be performed by women and boys. The trees, also, as they are cleared from their branches, should be carried out to the roads, and assorted according to their sizes.

In this way the whole work of cutting down and carrying out the trees and their branches should be performed, taking care that the workpeople, in the act of carrying out the wood, do not put their feet upon the stocks; for by their doing so, the bark would very likely be broken from the edges, which would of course be injurious to them. The work of carrying out the wood should therefore be carefully performed; and, in order to see this done, a careful man should superintend it.

1190. The trees being all cut, and their produce carried away from a certain tract of ground, so as there need be no cause for apprehension of danger to the stocks, another man with a *sharp adze* will round the edges of each stock. In doing this, he must attend to go close down to the surface of the earth with the adze, taking with it both bark and wood, sloping it up neatly all round to the centre of the top of the stock. He must, at the same time, be most careful that the bark and wood have the same slope, for if this is not attended to, water may lodge upon the bark and cause rot there. He must also be cautious not to separate the bark from the wood.

1191. All the work relative to which I have now been speaking, ought to be performed by the proprietors' own people, and not let to contractors, as is too often done, to the great hurt of the stocks, and consequently of the future crop of coppice. Another serious obstacle to the welfare of coppice-woods in England is, the bad practice that prevails of allowing purchasers of coppice plantations to cut it down themselves. Now, I beg to say that, in the articles of sale, the proprietors ought to reserve the cutting in their own hands, which would be greatly in favour of their woodland property.

1192. What I have said above is only applicable to those sorts of trees, the wood of which is not used for powder charcoal, nor the bark for tanning. Of course, in the cutting of the trees and the preparing of the stocks, the same rules are to be observed in all cases. But the oak, the bark of which is an important article, must be stripped as the trees are cut down. (For a description of how this work is to be performed, see section headed *Stripping and drying of Bark used for Tanning.*) But even in the case of stripping, the wood must, in the first place, all be carried out to the road where the operation is to be performed. There is also the birch wood, the bark of which is used for tanning, and the wood for charcoal; and the alder, the bark of which is of no use, but the wood requires to be stripped before being sold to the powder manufacturers: the wood, after being stripped of its bark, sells at from 20s. to 25s. per ton, according to demand. Hazel and mountain ash are also much sought after by powder manufacturers: the bark of these two is useless; but the wood must be stripped, in which state it sells at the same price as the birch and alder. In all cases of making charcoal, it is not necessary to peel the wood for that purpose. I have made a considerable quantity of charcoal for colour and paint makers; and as it is not necessary that it be of so fine a quality as when used for gunpowder, it is generally made from wood with the bark on.

1193. As many foresters may have occasion to make charcoal in the same manner as I do, I shall here, for the guidance of those into whose hands this book may fall, give my method of proceeding; and as the system which I practice is the same as that detailed in the *Encyclopædia Britannica,* I shall quote the description from that work.

" The wood being collected near the place intended for the operation, and cut into billets, generally about two feet in length, the pits, or stacks, are generally formed in this manner:—A spot adapted to the purpose, of from about fifteen to twenty feet in diameter, of a conical form, is selected, and, being properly levelled, a large billet of wood, split across at one end and pointed at the other, is fixed in the centre of the area, with its pointed extremity in the earth, and two pieces of wood inserted through the clefts of the other end, forming four right angles. Against these cross-pieces four other billets of wood are placed, one end on the ground, and the other leaning against the angles. A number of large and straight billets are afterwards laid on the ground, to form a floor, each being, as it were, the radius of the circular area. On this floor a proper quantity of brush or small wood is strewed, to fill up the interstices, when the floor will be complete. And in order to keep the billets in the same position in which they were first arranged, pegs or stumps are driven into the ground, in the circumference of the circle, about a foot distant from one another. Upon this floor a stage is built, with billets set upon one end, somewhat inclining towards the central billet; and on the tops of these another floor is laid, in a horizontal direction, but of shorter billets, as the whole is intended, when finished, to form a cone. The whole is then coated over with turf, and the surface generally plastered over with a mixture of earth and sand. Previous to the operation of setting fire to the pile, the central billet in the upper stage is drawn out, and pieces of dry combustible wood substituted in its place, to which the fire is applied. Great attention is necessary during the process in the proper management of the fire, and in immediately covering up the apertures through which the flame obtrudes itself, until the operation be concluded, which is generally effected in the space of *three or four days*, according to circumstances. When the charcoal is thought to be sufficiently burned, which is easily known from the appearance of the smoke, and the flames no longer issuing with impetuosity through the vents, all the apertures are to be closed up very carefully with a mixture of earth and sand; which, by excluding all access of the external air, prevents the coal from being any further consumed, and the fire goes out of itself. In this condition it is suffered to remain till the whole is sufficiently cooled, when the cover is removed, and the charcoal is taken away. If the whole process is skilfully managed, the coals will exactly retain the figure of the pieces of wood. Some are said to have been so dexterous as to char an arrow, without altering even the figure of the feather."

1194. It will now be necessary to say something as to the management of the willow or osier beds; which, of course, has not been included in what has been stated with regard to the other coppice.

The ground for this crop of coppice having been trenched, dunged, and cleaned, and the willows planted in the manner formerly stated, they must, whether intended for the basket-maker or cooper, be allowed to remain uncut for two years, with the view of strengthening the stocks; but being cut over at the end of the second year, the crop produced from the stocks will be ready for the basket-maker one year after; that is to say, one year's growth is what is used by them; if the crop should be meant for coopers' hoops, growth of two years will be required. The best time of the year for cutting over the willow is the month of February. In cutting them over for the first time, three buds should be left from the bottom, and the cut should be made in a sloping direction; but at the after cuttings, the shoots should be taken away, leaving only the swelled parts from whence they issued. The willows as they are cut should be immediately carried off the ground, assorted into three sizes, and tied in bundles of two feet in circumference within a foot of the lower ends; in which state they are sold. When they stand two years and are fit for coopers' hoops, they should be trimmed from any side branches, and tied up in bundles of six scores, in which state they are ready for sale. As soon as the crop is carried off the ground, it should be dug, and in the summer kept clean from all weeds.

1195. We shall now suppose that all the trees which were planted with the view of becoming coppice-wood, have been cut over for the first time, in the manner which has been directed above; and shall now follow the progress a little in the coppice state, which is the end we have in view in the present section.

If the trees were all cut over in the months of February and March (excepting the oak, which must be cut in June, for the sake of its bark), the stocks will, by the middle of June, have sent up a large supply of young shoots from the collar all round. These are termed coppice shoots, of whatever kind the tree may be. In the autumn of the same year, the whole plantation which was thus cut over, will form a coppice of one year's growth. In England, where this sort of forest cropping is more extensively cultivated, such a plantation, at the period we are now referring to, is generally left entirely to nature; but this is by no means the proper way of going to work. Where it is intended to have valuable coppice, such plantations should have each stock thinned of all superfluous growths at the end of the second or third year, according to the rapidity and strength of the growths; but in general, we may say, that when the coppice is of two years' growth, each stock should be thinned out, leaving from three to six of the best shoots upon each, according to its strength, to bring them forward. This should be done to every sort of young coppice, excepting the willow, which we do not here take into consideration. Allowing, then, that the stocks in the plantation have all been thinned at the above period, and the thinnings, as cut out from each stock, sold for hamper and crate stuffs, much profit will be at the time derived from those thinnings, without taking into calculation the superior value to be derived from the future crop by such a method of procedure.

1196. As to the period at which coppice plantations should be cut over, no definite number of years can be stated as sufficient to bring them to a certain size. For example, taking the oak as a standard in our calculation, in Herefordshire oak coppice is as bulky at twelve or fourteen years as it is in Argyleshire at twenty-five years; and this points out that all depends upon the nature of the climate, the soil, and the shelter. Besides, as to the time of cutting down the crop of coppice, much depends upon the nature of the demand for the crop; thus, in some parts of England, where much of the coppice is used for hamper, crate, and coopers' stuff, it is cut over at two and three years of age ; in other districts, where much of it is used for hop-poles, it is cut over at four, five, and six years old ; and in others, where it is used for fencing, and many other country purposes, it is cut over at from ten to fifteen years of age. In Scotland, again, where oak coppice is chiefly grown for the sake of bark and spoke-wood, it is left till it is from five to seven inches diameter at the base. At whatever age coppice may be cut over, the work should be done by the proprietor's own people, allowing the purchaser to dispose of the wood as he pleases, unless, indeed, the latter can be properly bound to do the work on a right principle, and to the satisfaction of the forester on the place.

1197. In cutting over the coppice, the saw should in all cases be used where the shoots are above four inches diameter at the base ; but when they are of a smaller size, they may very properly be cut over with the handbill, which should be kept in a sharp state for the purpose. In cutting away the shoots, they should be hewn closely in upon the swell at the base, and neatly rounded off, so as to present no inequalities or roughness for the lodgment of wet. At the same time, attention should always be given to keep the centre of each stock higher than the margin, in order to throw off the water and preserve them in a sound state. This can only be effected by the woodman, at every cutting of the coppice, dressing the stocks all round close to the earth ; taking care, however, not to loosen the bark upon the tops of the roots ; for if this be done, rot will be sure to take place there ; nor should any earth be allowed to be put over the cut part, as this also would encourage rot.

1198. In the course of time, when several cuttings have been taken from the same plantation, it invariably happens, under bad management, that the stocks extend themselves to an extraordinary size, spreading themselves wide in circumference, and becoming rotten and hollow in the centre. This state of things should be guarded against ; and under good management it seldom takes place to any great extent, at least for a very great number of years. The only way to prevent it is by cutting close to the old stocks at every period when cuttings take place, and being very careful to smooth over the whole, so as to prevent the wet from making lodgment upon it. In order to renew old and worn-out coppice plantations, the only sure and effectual way is to replant ; and, indeed, this will be found in the end the most profitable way, at least in instances of extremely old coppice-woods. In all oak coppice plantations, I find, from experience, that no cutting should be allowed after the 1st of July—that is to say, if a healthy growth of young shoots is valued for a future crop.

1199. I now come to say a little relative to the value of coppice-wood as a forest crop. This, of course, must in all cases depend a great deal on the nature of the soil and situation upon which the stocks grow, and also upon the management they may have received while in their young state. Much as has been said by some authors relative to the great profits arising from oak coppice, I have not myself found this species of crop nearly so valuable to the proprietor as that of rearing the plants to full timber size; and from this circumstance I am led to recommend to proprietors the rearing of timber plantations in preference to coppice ones. From the experience I have had in the sales of oak coppice, 30s. per Scots acre is about the average yearly rent of the land derivable from such a crop. Birch and alder coppice I have found to produce, at an average, about 22s. per acre; ash coppice, 48s. per acre. Coppice of a general mixed character I have never found profitable, seldom realising more than 15s. per acre per annum. The above valuations are taken from coppice cut down at periods between twenty and thirty years.

1200. In some extreme cases, I have known oak coppice, at twenty-five years old, sell at £66 an acre; and I have seen alder and birch, at the same age, sell as high as £40: but these must be considered as extreme cases, and I have oftener seen them sold at a rate much more below the average I have given than these are above. In Lancashire, even though there is a great demand for coppice-wood stuffs in Manchester and Liverpool, the land under such a crop seldom produces above 30s. an acre to the proprietor, while much oftener it is from 15s. to 20s.; and that, too, upon land which, if put under good forest management for the cultivation of large timber, would without doubt realise three times the sum. Having witnessed this state of forest matters in England, I shall conclude this section by pointing out the manner in which coppice plantations might be converted into profitable timber plantations.

1201. In the converting of any coppice plantation into one which is to be trained up as timber, the sooner after the cutting of the crop of coppice this is had in view, the better. The not having attended to this point is the cause that several coppice plantations, which have of late years been turned into timber ones, have not succeeded according to expectation; the reason of the failure being, that the coppice was allowed to grow up in the usual manner, and until the usual period for the cutting of it, before a selection of proper shoots was made for becoming ultimately timber. With the mistaken view of taking as nearly as possible a full crop of coppice shoots from the stocks before converting them into timber-bearing ones, some foresters have recommended the system of leaving, at the time of cutting down the coppice, only as many good shoots as will ultimately become timber trees upon the ground, at distances from twenty to thirty feet, and advising, at the same time, to allow all the coppice stocks cut over to bring forth another crop, while the shoots that are left are becoming timber; thus endeavouring to carry on both systems upon the same piece of ground, until those that are meant to become timber are large enough to fill the ground themselves. Than this, no system could be more certain to frustrate the end in view.

1202. How can the shoots of trees be expected to succeed so as to form timber, which are for a number of years confined in a close plantation, and all at once suddenly exposed, as is the case when they are chosen to stand, and all the rest of the shoots which formerly sheltered them are cut away? We might as well expect a child to grow up to healthy manhood, who, from being closely confined in a room, was at once taken out and set down upon a bare moor. Unreasonable as this system must ever be, it is, notwithstanding, frequently practised—of course, to the sure failure of the trees so dealt with. I have seen this system practised in England; and, from receiving such bad treatment, the trees were in an unhealthy state, while the cause of the unhealthiness was not attributed to the system, but to the bad character of the soil.

1203. The only sure way of converting a coppice plantation into healthy standing timber is this:—When the regular coppice has been thinned for the first time, say at three years old, have in view the raising of a regular portion of the best of the shoots for ultimate timber; and with this view, thin out all the weakly shoots and such as are badly formed, and leave none but the choicest, and those rather thinner upon the stock, than if the plantation were merely thinned with the intention of its remaining under coppice. Having thinned the coppice rather severely at three years' standing, at six years let it receive another good thinning, by taking away from each stock the worst of the shoots, leaving none but the best, and not more at that age of these than from four to five upon the most healthy of the stocks. At nine or ten years of age give another regular thinning; at about fifteen, a fourth; and at eighteen years, there should upon no stock be left more than one shoot, which is designed to be trained up as a timber tree. After this period, such a plantation may be treated exactly in the way which has already been directed for hardwood plantations. The advantages of this system are evident. First, The trees are trained up gradually and naturally, and never suffer any check; second, A better selection can be made, from there being a continual choice of shoots at the command of the forester as they grow up at different stages; and, third, By this method of selecting and training up, the plants, or trees as we may term them, at nearly twenty years old, will be twice the size that others would when merely chosen from the body of a thick coppice-wood and exposed all at once; and by the time that they are thirty years old, they will be three times as large, and I may also add, three times more healthy and valuable.

1204. As cases may occur where proprietors may wish to convert a coppice plantation of some years' growth into a timber one, I may state for their guidance, that at whatever age they may wish to do this, they should never commence to cut down suddenly, and expose the shoots they wish to rear up as trees. The only sure way in a case of this kind is, to select the very best of the shoots at proper distances from one another, and have them pruned and kept clear from the other shoots upon the other stocks. Those also should alone be selected which appear to come away from the earth, and not those which have the appearance of coming away from the collar of the stock; for such never will come to make good trees. As those that are made choice of advance in size, give them room gradually, and eventually a good standing timber plantation may be formed in this way, cutting away all the rejected shoots betimes, in the same manner as in the case of thinning away nurses from among young hardwood trees in any other timber plantation.

Upon many places I have seen oak coppice shoots, somewhat above forty years old, measuring forty feet high, and three feet in circumference five feet from the ground.

SECTION II.—MANAGEMENT OF OAK COPPICE.

1205. Plantations of the description termed oak coppice are now so common in Scotland, that there are few landed estates of any considerable extent upon which there is not less or more of them. In the West Highlands there are many extensive plantations of this kind; and within the last thirty years many fine old oak forests have been cut down in the midland counties, which also are, for the greater part, now converted into plantations of this description—being trained up from the young shoots which have arisen from the stocks of the old trees that were cut down. Seeing, then, that this description of wood crop is of some importance upon the estates of many landed proprietors, it may not be out of place here briefly to detail the best modes of its management, more particularly with the view of pointing out the most profitable manner of going to work in the converting of old oak forest ground into healthy young coppice-wood.

1206. When a plantation of old oak trees is cut down, and when it is the intention of the proprietor to convert it into a coppice-wood, for the purpose of raising a crop of oak bark upon the ground, the work must be proceeded with in the following manner:—First, the whole of the wood of the original trees, when cut down, should be removed immediately, as also all the bark taken from them, in order that no damage may be done to the young shoots as they arise from the newly-cut stocks; for, if the wood be allowed to lie long upon the ground after it is cut, the young shoots will have grown to a considerable height, and they, being extremely tender, will be easily broken in the act of removing the wood at a late period. In order, therefore, to prevent this taking place, if the wood have been sold to any neutral person, say about the 1st of May, he should be bound by the articles of sale to have the whole of both wood and bark removed by the 1st of July at the latest. If this be not done, much loss will certainly be sustained in the after-crop of the coppice-wood, seeing that it is impossible to remove heavy timber from the ground without rolling it over the shoots in their tender state.

This part of the work is always best done by the proprietor's own servants, and under the superintendence of an experienced forester; because, in such a case, the people who cut the wood are paid by the proprietor, and being so, will look more to his interests, or at least will attend more to the orders given them, than strangers from a distance would do, whose only interest is that of getting the wood cut down at as little expense as possible, without any regard to the future value of the plantation. It is also necessary to notice here, that in cutting down any large oak tree, the stock of which is intended to push up young shoots for the formation of coppice, great care is necessary to see that the bark is not injured below that part where the tree is cut over; for if the bark be hurt and ruffled there, so as to separate it from the wood, moisture will be lodged between it and the wood, and, consequently, rot at that part will be apt to take place. In order to prevent this, it is always a good plan, previous to commencing the operation of cutting down the trees, to employ a cautious, trustworthy man to go before the wood-cutters, who, with a *handbill* and wooden mell, should be instructed to cut the bark right through to the wood, in the form of a ring all round the circumference of the tree, about three inches above the surface of the ground. This first ring being cut all round, another should be made in like manner about twelve inches higher up on the boll of the tree, when the piece of bark situated between those two cuts can be removed, and the woodman made to saw each tree across exactly by the lower mark, or bottom of the peeled wood. This forms a guide to the men not to injure the lower part left with the bark upon it, as well as, when any difficulty is experienced in bringing the tree down, avoiding all waste of bark.

1207. As soon as the wood and bark have been removed, all rubbish and useless underwood should be carefully cleared away, excepting any young healthy shoots, or young plants which may be considered worth leaving upon the ground, with the view of their ultimately becoming trees. And immediately after the ground has been cleared of rubbish, the stocks of the old trees should be dressed with the adze, in order to cause the young shoots to come away as low down, and as near to the surface of the ground, as possible. If the young shoots of the oak, which are intended to grow up into coppice, be allowed to proceed from that part of the old stock which rises two or three inches above ground, these shoots will always partake more of the character of branches than of trees, and never will make a valuable plantation; but if made to come away from that part of the stock where the roots join with the main stem, and which lies immediately under the surface of the soil, they will partake of the character of trees, and, independent of the nourishment that they receive from the parent stock, will also send out roots of their own, and derive nourishment from the common earth, and form pretty large trees, if desired. Now, in order to cause the young shoots to issue from this point, the long grass should be all cleared away round the stock, and itself dressed off with an adze. In executing this, care must be taken that the part where the roots issue from the main stem be not injured; but supposing that three inches of wood have been left above ground upon the stock, the workman should commence by levelling his tool upon it fully two inches down upon the wood, and hew off this part all round, gradually lessening the depth of his cut as he nears the centre or crown of the stock, which is left untouched, thus leaving a fall from the centre to the circumference of fully two inches, and forming a convex crown. This form prevents the lodgement of moisture, as well as causes the young shoots to come away as near to the earth as possible, which should always be aimed at; and in this manner every stock which may be intended for the rearing up of coppice-wood should be managed. The sooner the operation is done after the trees are cut, the greater is the hope of a good crop of healthy shoots: the forester, therefore, ought not to delay this until all the other work of clearing away the trees and rubbish be finished. The whole ought, indeed, to be gone on with according to the time that I have above stated, but still the whole may be proceeding simultaneously. My way of proceeding with work of this kind is:—I have a party of men with horses and carts, who begin upon one side of the ground, and clear away all the valuable wood as they proceed, which is delivered to the sawyer or otherwise as the case may be. Immediately following this first party I have a second, consisting of women and boys, headed by a man to superintend them, who gather up all the rubbish that is left by the men with the carts, and carry it to convenient openings, and burn it at once, unless some other more valuable use can be made of it. The ground being cleared by this second party, I have a man, or men if the grounds be extensive, following them dressing the stocks in the way described; and in this manner the whole work can be made to go on at once without losing any time.

1208. If the stocks of the old trees which were cut down are not numerous upon the ground, as is more than likely to be the case if the trees were of any considerable age, there will not be enough for a permanent crop upon the ground. If, for instance, they were eighty years old, there will not be more than one hundred trees to the acre, making them about twenty feet one from another. Now, to have a piece of forest ground with that number of stocks upon it to the acre, would never pay the proprietor the common rent of his land: therefore, in order to take advantage of the ground forming the vacant spaces between the stocks, and to make the whole pay ultimately as any other plantation would do, the ground should be properly drained wherever found necessary, and a crop of young oak trees planted all over it wherever there is room. In this case, the young oaks which may be put in, together with the old stocks, may be made to stand, as nearly as possible, eight feet apart. All the intermediate spaces between them should be filled up with larches, so as to make the trees over the whole plantation stand about four feet one from another; that is, taking the old stocks into account also.

By filling up the ground in this manner, the old stocks will ultimately become of more value than if they had been left in an exposed state; while, from their growing more rapidly than the young trees, they will produce shelter to the latter in their young state; so that, putting the whole together, a plantation of this kind grows more rapidly than one altogether planted with young trees.

1209. When the young shoots from the old stocks have been allowed to grow undisturbed for two years, they should then be carefully looked over, and all small ones removed, leaving the strongest, all round the circumference, not closer than six inches one from another. These again should be left for other two years, when a second and final thinning should be made, choosing the strongest and healthiest shoots to remain, and in no case leaving more than six shoots to stand as a permanent crop upon any individual stock, or fewer still if the health and strength of the parent require it.

1210. I am aware that many foresters are in the habit of not thinning the shoots from their oak stoles at all, until they have attained a large size, when they thin them out and strip the bark from them, supposing that by this system there is a gain from the sale of the young bark produced. I entirely dissent from this system of management; for, when the shoots are thinned out as I have advised, they very quickly attain a large size; whereas, when they are not thinned out until a late period of their growth, the shoots become stunted, and shortly indicate a want of vigour in their constitution ; consequently, at the end of a given number of years, instead of an advantage being gained by letting the shoots grow up until they are fit for stripping, there is a decided loss. I have compared two plantations which were managed upon these two different systems, and found the one managed upon that which I have recommended, at the end of twenty years, worth nearly a half more than the one managed upon the opposite system.

1211. When the young shoots have received their second course of thinning, as has been pointed out, they should at the same time receive a judicious pruning, in the same manner as has already been recommended for the pruning of young oak trees. The larch, as they grow up, should be thinned away by degrees, in order to give room to the oaks as they advance, whether to relieve the shoots from the old stocks or the young trees ; and in every respect this thinning of the larch should be done as has already been recommended for the management of oak plantations generally.

1212. Seeing that the value of oak bark has fallen so much during the last twenty years, I do not consider the growing of oak coppice so profitable as it has been. About thirty years ago the price of oak bark was £16 per ton, while in 1859 the highest price we could obtain was £8 ; making its value at the present time only one-half of what it was thirty years ago, and consequently reducing the value of oak coppice plantations in the same ratio. On this account, I think that proprietors should not, at the present time, rear up oak plantations with the intention of converting them into coppice, as has in many instances been done of late. I have seen plantations of healthy oak trees, about thirty-five years of age, cut down for the sake of the bark they produced, and with the view of converting them into coppice-wood, so as to have a crop of bark every twenty-five years afterwards. Now, had those trees, which were cut down at thirty-five years of age, been allowed to grow for other forty or fifty years, they would, of course, have attained their full magnitude, and been worth to the proprietor, at the end of that period, more than three times the money that he could get as the produce of the same plants if cut down and disposed of in the form of coppice-wood, at periods of twenty-five or thirty years.

1213. The safest and best plan, with regard to all plantations, is, to allow the trees to attain their full magnitude in the usual way, when the timber will in all cases find a ready market, and at a fair price. No doubt, where old plantations are cut down, it is right and proper that the stocks of them should be converted into coppice-wood ; for this is taking advantage of growths which can be converted to use, and which would otherwise be lost ; but to raise up trees to a certain age, and then cut them down prematurely for the sake of their bark, is, at best, an enormous loss to the proprietor, as well as to the country in general.

SECTION III.—THE STRIPPING AND DRYING OF BARK USED FOR TANNING.

1214. The stripping and drying of bark used for tanning being a part of forest operations in which an inexperienced person may be the cause of much loss to his employer through bad management, I have considered it right to devote the present section to giving some information relative thereto; and in this I shall merely detail the method by which I am in the habit of doing the work.

1215. There are, properly speaking, only three sorts of wood, the bark of which is now used for tanning purposes—namely, the oak, the larch, and the birch. About forty years ago, when the demand for bark was very great, I have seen saugh, chestnut, and mountain ash all stripped, and the bark sold to the tanners; but now that there is a large supply of oak bark imported into this country from the Continent, tanners will not use these, seeing they can get plenty of good oak bark at a very moderate rate; and it is in consequence of this large supply from the Continent that the price of bark has fallen so much.

1216. To illustrate the method of stripping and drying the bark, we shall now suppose that we have to commence operations of this nature upon a crop of oak coppice of considerable extent. We shall further suppose that this plantation of oak has been trained up for some time with the view of becoming a timber plantation ultimately; that the shoots or trees are about twenty-five years old from the stock; and that, at the thinning which we are now referring to, there is only intended to be one left from each stock.

1217. A few days before commencing the cutting and stripping, the forester will go through the plantation himself, and mark all the shoots he intends shall be taken away. This I advise him to do, in order that he may have time and leisure to mark quietly by himself; because, if the plantation be extensive, and many hands employed, he will find enough to do, when the people have begun, to keep them properly at their several employments, without marking. Where many hands are to be employed, therefore, the forester should have all his trees marked previous to beginning to cut and strip, by which means he will be enabled to give his undivided attention to the conducting of the workpeople. We shall suppose that the business of marking the trees which are to be taken out has been despatched according to the rules already laid down in another part of this book. He will next consider as to the number of people he will have to employ in order to have the work done within a given time; and this of course must be regulated by the forester's own views as to the time he has on hand. But as an inexperienced forester may find some difficulty in arriving at something like accuracy as to the time it may take him to have his work of stripping done, I shall here give him for his guidance the rule by which I myself determine this.

1218. When I wish to know, as nearly as possible, the weight of bark that I am likely to have from a plantation, I first take three of the shoots or trees which are to be cut—say of three different sizes—one of medium small size, one of a middle size, and one of a medium large size. These three trees I get stripped, including the branches upon them; and supposing the bark taken off the three weighs 39 lb., this gives 13 lb. as an average of the raw bark which may be expected from each tree to be cut. Having ascertained thus far, the next thing is to find the number of trees to be cut in the plantation. This of course the forester ought to know by the act of marking them; and this he may keep in view as he proceeds with the marking. Supposing, then, that he numbers 7466 in all to be taken out, then, if we assume that the raw bark in drying loses about one-third of its weight—this being my principle of calculation—we have only about 8¼ lb. instead of 13 lb. as the weight of bark off each tree when dried; and multiplying 7466, the number of trees to be cut, by 8¼, the number of pounds of bark supposed to be taken from each tree, we have in all 61,594 lb., or 27 tons. From the above method of calculation, the forester may come very near the truth; and I generally myself come within 5 per cent of the truth by going to work in this way. Having ascertained that 27 tons of bark are likely to be taken from the plantation, the next point is to ascertain what number of people will be required to strip this in 27 days, to which we shall suppose the forester is obliged to confine himself:—

1219. By calculations made from cases of stripping bark of the age stated above, I find that, in order to strip one ton of bark in the day, and carry out the wood as it is cut to the roads, a distance of one hundred yards, where it is to be stripped, the following workpeople are required:—

Two cutters, at 2s. 6d. per day, ...	£0	5	0
Two pruners of trees, at 2s. per day, ...	0	4	0
Four subpruners, or lads, pruning branches for strippers, at 1s. 6d. per day, ...	0	6	0
Three men carrying trees, at 2s. per day, . .	0	6	0
Three boys carrying branches, at 1s. per day, . .	0	3	0
One man putting up stages and attending to bark on them, at 2s. per day, ...	0	2	0
One boy carrying bark to stages, at 1s. per day, .	0	1	0
Twenty women and boys stripping, at 1s. each per day,	1	0	0
Cost per ton, ...	£2	7	0

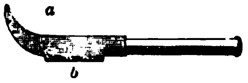
1220. In order, then, to cut and strip the number of trees above mentioned, in the space of twenty-seven days, thirty-six people will be required, as above stated; and these the forester ought to have in readiness, by a previous appointment, to meet him at the given time and place. Before bringing the strippers to the ground, the forester should attend to have the *cutters*, *pruners*, and *subpruners* employed during the afternoon of the previous day, in order to have a supply of wood ready for operation when the women and boys arrive; for if this be not attended to, a great deal of time will be lost, from the strippers all having to wait till wood is cut and carried out for them. We will suppose that the two cutters have been engaged upon the afternoon of Monday, as also the two pruners, with the four subpruners, and that there is a supply of wood ready for the strippers commencing with upon the morning of Tuesday.

Before stating the manner in which the women, or people who are employed for stripping the bark, are to be set to work, it will be proper to begin with the cutting of the trees, and then go on progressively with each department in its own place, according to the regular course of the work.

1221. Let the two men who are engaged for the purpose of cutting down the trees proceed each to a separate stock, and with his axe cut down each shoot upon the stock having a mark upon it. But if any of the shoots or trees are of a size about or over six inches diameter at bottom, they will require to join together, and cut them down with the cross-cutting saw, observing, in either case, to cut each tree down to the surface of the earth as nearly as possible, paying particular attention not to do any injury to the bottom of that shoot which is left in order to become the future tree. In this way they will proceed from stock to stock in regular course, cutting every shoot having a mark upon it in their way; and as the marks ought to be all made on one side, and facing one way, they will have no difficulty in quickly finding them out. Another point which these men ought particularly to attend to, is to see that none falls upon the shoots which are to stand, they always endeavouring to lay them over in an open part. In this manner the two men will continue to cut down the trees, paying no attention to the pruning of any of them after they are fallen, their particular charge being merely that of properly cutting down the trees marked; and that the forester ought to see done in a clean, workmanlike manner.

1222. As the trees are cut and laid down by the two men as already stated, they should be followed in close succession by other two men, who may be of an inferior cast as workmen, as their duty is not of so important a nature. Their duty is to prune, or, as it is technically called, *to snead* the trees of their branches as they are felled; and in cutting the branches from the trees, they must be instructed to cut them off in such a clean manner as not to destroy the bark upon the main stem of the tree. That they may do this the more readily, they should be furnished with axes of a lighter description than the common wood-cutting axes. If the wood-cutters lay down the trees with the axe, each working separately by himself, then each will be followed by one pruner; but if they use the saw, both working together, the two pruners will follow them accordingly, each taking a tree to himself in turn, clearing it of all its branches, and cutting off the top of the tree where it is from two to three inches in diameter, leaving the trees and their branches lying as they were cut; and these will again be taken up by another party coming behind them.

FIG. 133.



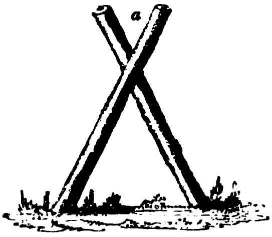
1223. Immediately behind the two last-mentioned men, four young lads will follow, each having a *handbill* in his hand (see Fig. 133), which is kept sharp both on the curved side, *a*, and upon the straight face, *b*. With an instrument of this description in the right hand, each lad will take up a branch in the left, by the thick end, and with the handbill prune off all the smaller branches; and those branches which they thus cut off may be subpruned again, if they are of a size equal to the middle finger of a man's hand: in short, it must be the duty of these four lads to prune out all the branches down to the size mentioned. As they prune them out, the lads must be careful to put them into bundles in a regular manner, that they may be readily lifted and carried out of the wood by another party behind them. It will be the duty of the forester to see that these lads do not pass over any of the branches; for this they are very apt to do, in order to keep up with the men in front; and if such omissions are once allowed to slip, they will, as young lads are very apt to do, put off their time, and still keep up with the men in front. It must, therefore, be particularly seen to, that they do not pass over the branches, and thereby lose a considerable portion of bark. Young lads performing this operation are generally termed *subpruners*.

1224. After the three parties above mentioned are well begun, another party of three men and three boys will commence to carry out the wood, the trees and branches, namely, as they have been prepared by the foregoing parties, and lay them down along the nearest road in the wood, in order to their being stripped. In carrying out the wood which has been cut, the three men will carry out the trees, two of them carrying the heaviest upon their shoulders, and another the lighter ones by himself, while the three boys carry out all the branches as they are pruned and collected into heaps by the subpruners. In this way the whole of the trees marked are to be cut down, pruned, and their branches subpruned, and carried out to the nearest road, in order for stripping; the one party following the other in regular succession, clearing the wood as they pass along.

1225. In laying down the trees and branches in order for stripping upon the roads, the carriers must attend to divide them in such a manner as to accommodate the number of people who are to be employed in stripping. Thus, in the present case, where twenty people are supposed to be engaged in the latter, one-third of that number will be sufficient for the stripping of the *trees* as they are brought out, while two-thirds will be required for that of the *branches*. The forester will, therefore, cause the carriers to lay down the trees in three divisions along the side of the road (not across it), and at each of these three divisions two people will be employed, it requiring two people to strip the trees to advantage; and thus one-third of the people—namely, six—will be engaged in the stripping of the larger wood. The other fourteen people, again, will be engaged in the stripping of the smaller wood; therefore, fourteen heaps or divisions of small wood must be laid down for them, so that each person may have his or her own heap to work on. By going to work in this manner, it will be at once seen by the forester who works to advantage, and who does not; for if a number of people were set to the stripping of one heap or compartment of sticks, the forester could not so easily detect a bad hand from a good one. This is a point that every forester engaged in the stripping of bark should direct his attention to, to deal out his work so as to be able to detect a lazy from an active worker, and he ought in all cases to reward them accordingly. Every one who has had experience in the stripping of wood, where a number of strangers are brought together, will coincide in what I have here stated.

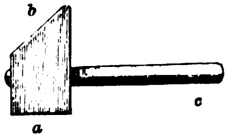
1226. The wood for stripping being laid down along the side of the road as has been described, it will be necessary for the stripping of the trees to have a pair of what are termed *horses*, erected at each of the three heaps. (See Fig. 134.) This is simply done by driving two strong stakes, of about three inches in diameter, into the ground, as represented in the figure. Two of these are put up alongside the trees to be stripped, about eight or ten feet apart from each other, and they may stand thirty inches high. They are used to lay the ends of the small trees upon, as at *a*, by which means the operators can the more readily get the bark taken from the trees so placed,

FIG. 134.



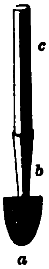
without rolling them about upon the ground. These being prepared by some of the men previous to the women having arrived for stripping, the next thing is to have them brought forward to the ground.

FIG. 135.



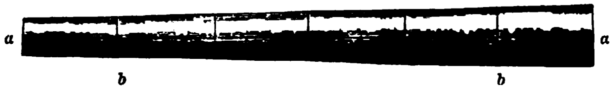
1227. On the arrival of the strippers, the forester will have in readiness for each a small mell, of the form represented by Fig. 135, the head of which must be made of a piece of good ash wood, but the handle of Scots pine, as it is more soft and cool for the hands than any other sort of wood. The flat part of these mells, *a*, is for beating the bark upon the wood till it separates easily from it, when such an operation is found necessary, and the sharp part, *b*, is for cutting up the bark, so as to open it for the purpose of introducing the stripping chisel, another little instrument which every stripper must have in hand, and which must also be provided by the forester for them: it is represented by Fig. 136. The mell may be made about four inches square on the flat part *a*, and about six inches deep from *a* to *b*, the handle *c* being about ten inches in length. The chisel should be made of good iron, three inches by two and a half in the face *a*, and the hose *b* may be about four inches in length; while the handle *c*, which is of wood, may be about eight inches long. Those who are occupied in stripping the small wood, should be provided, in addition, with a stone from eight to ten inches square on the top, and about six inches deep, and as smooth as possible on the one side. Such stones may be got from any old dyke in the neighbourhood of the plantation, or in the bed of any small watercourse near at hand.

FIG. 136.



1228. We shall now suppose that all the people who are to be engaged in the stripping of the wood are in readiness to begin, with the tools described above; and we shall also suppose that they are all strangers to the work, and have to be instructed in it by the forester before they can make a beginning. First, then, the forester will pick out six of the stoutest from among the others, whether these may be women or young stout lads, and set them to the stripping of the trees; that is, two to each lot, as was formerly mentioned when speaking of the manner of laying out the trees upon the road. He will cause them to lift, first, the heavy end of one of the trees upon one of the wood horses prepared for the purpose, and then the small end upon the other. When this is done, one of them will take a handbill, of the description shown in Fig. 133, and with it cut the bark right round the tree, into lengths of about three feet, beginning at the thick end. This being done from end to end of the tree, dividing the bark upon it into lengths of about three feet, he then, with the same instrument, cuts it longitudinally, from the one end to the other—the bark thus being divided as shown in Fig. 137, *b b* representing the transverse cuts, and *a a* the longitudinal cut. Now in order that while the one person is engaged in cutting the bark in the manner described, the other may not be idle, he will, with his mell, using the flat end, beat the surface of the bark upon the tree all round—but very softly and slightly—beginning at the thick end, and following his neighbour in regular course. This beating of the bark must on no account be done in a rough or heavy manner, for such a course would injure its colour when dried; but regularly, so as to cause the bark to *start* from the wood. The thinner the bark is, the less beating will be required; in fact, it is better not to beat at all, unless the bark is very strong, and somewhat difficult to raise from the wood; consequently, at the bottom of the tree, and upwards to the middle, a gentle stroke of the mell may be required; but as the bark becomes thinner from about the middle of the tree upwards, a still more gentle beating will do, or none at all, if the bark will rise with the chisel. All this the people who are employed should be made aware of; as the more knowledge the people have of the real nature of the work, the more profitable they are as workmen. As soon as the person has got the bark cut into lengths in the manner described, he will put aside the handbill and take his chisel, and with it he will follow his neighbour, and separate the bark from the wood, taking it off in pieces corresponding to the cuts he made with the bill; and as he takes off each piece, he will lay it carefully and regularly to one side, so that it may not be in the way of the work in general. In this way the one will follow the other in close succession; and as soon as one tree is stripped of its bark, they will join in removing it to one side, and putting a fresh tree upon the horses; always observing to lay the stripped wood to the opposite side from the unstripped, as this will prevent confusion.

FIG. 137.



1229. We shall now suppose that the forester has shown the parties who are to strip the larger portion of the wood, how to proceed. It now remains for him to direct those who are to strip the smaller wood. In order to this, the best method is for the forester to show them himself by his own example. He will therefore call them all round him, and make them observe how he performs the work. He sits down upon the ground, keeping the bundle of small wood to be stripped upon his left side, and placing the stone upon the ground close by his left side also, with the smoothest side uppermost. He will next take an oak branch in his left hand from the bundle to be stripped, and lay the thick end of it upon the flat stone, and with the flat part of the mell he will beat pretty firmly till the bark opens from the wood, doing this from the one end to the other before laying down his mell. As soon as he has thus opened the bark from the one end to the other, he will lay it down by his right side, and commence at the thick end of the stick, and take it off in as long lengths as possible; that is to say, have as few small pieces as possible, because they are very apt to be lost. If the bark will not separate easily when laid hold of with the hand, he will take the chisel and separate it from the wood, and as it is taken off, have it laid in a regular manner upon the right side; while the stripped sticks should be thrown aside, so as not to interfere with the unstripped wood. When the forester has shown, by his own example, the method of stripping, he will cause them all to sit down and perform the work in the same manner.

1230. The next part of the work is to have a stage put up, upon which to put the bark as it is stripped. This should be intrusted to a careful person, who has had some experience in such work before. It should be done thus:—From among the stripped sticks collect a number, of the form shown in Fig. 138: these may be from two and a half to three inches in diameter, and about three and a half feet long. When a number of these are collected and carried to the place where the bark is to be put up to dry, which should be in some open and airy part of the plantation, or, if possible, upon the outside of it, where a free circulation of air will be continually had, have the sticks driven into the ground in pairs right opposite to one another, and in two rows, as represented in Fig. 139. In the figure, *a a a* represent a front view of the forked sticks as they are driven into the ground, and *c c c* the tops of the row behind and opposite to them. The distance between the two rows may be about thirty inches. *b b b* represent pieces of the stripped sticks resting between each pair in their forked tops; and *d d d* small trees of about two or three inches diameter, laid along on them

FIG. 138.

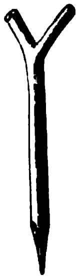
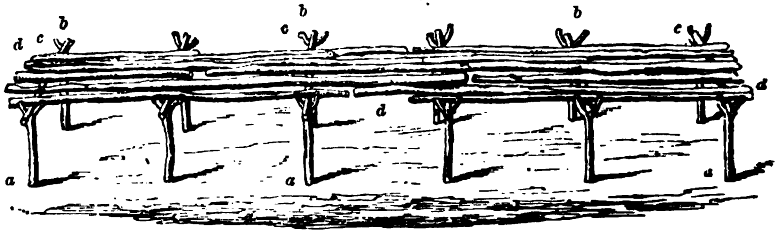


FIG. 139.



for the purpose of supporting the bark. The distance between these forked sticks, when driven into the ground, may be about four feet in the row; and in order that the rain may fall readily off the bark on the stage, the front row should be driven in with their tops about five inches lower than the back one.

1231. The stage for the bark being in readiness, a boy with a small sheet of any coarse stuff, will regularly carry it away from the strippers as they take it off, and bring it to the person who has the charge of keeping it in order. In laying the bark upon the stage, great care should be taken to put it on in a regular manner, and lying all one way, like drawn straw. A few large pieces of bark should be put on the top of the range first, in order to keep the smaller parts of it from falling through. The whole bark should be put on in a loose state, and by no means pressed together, but kept open in order to allow the air to pass freely through it; and it should not be laid on thicker than about fifteen or eighteen inches. On the top of the whole, as it is finished, large pieces should be laid, in order to keep rain from going down through it. As the person who has the charge of the bark stage will not have constant employment about it, he ought to assist at times any other of the parties who may appear to be falling behind.

1232. When the bark has stood two or three days upon the stage, it ought to be turned over and mixed properly; and in the act of turning it, all the freshest or rawest pieces should be kept to the top. If the weather continues fine, the bark may be dry enough in the course of fourteen days from the time of stripping; but if it is dull and cloudy, twenty-one days may not be enough. Its being properly dry may easily be known by all the natural sap being out of it, and its being hard and refusing to bend. When properly cured, it should be of a cream colour inside. When of a dark or brown colour, it is plain that the bark has been injured by wet; and when it is so, a lower price will be given for it. Great attention should therefore be given to see the bark properly dried, and this can only be done by repeatedly turning it in fine weather. The more quickly it is cured, the better it is in its tanning qualities. When dry, it may be either carted off the ground to the tanyard at once, or be built up in a stack upon the ground till a convenient opportunity for sale. When oak bark is to be sent to a considerable distance to the market, it is chipped into pieces of about three inches square, in which state it is put up into bags.

1233. In the stripping of birch bark, the same process is gone through as with the oak; but from its being more easily dried than the oak, it is seldom found necessary to erect a range for it, merely putting a few sticks under it upon the ground, and laying it regularly upon them, being sufficient.

Birch bark being less valuable than the oak, it is seldom or never chipped and put into bags, but sent from the wood to the nearest tanyard on the carts as soon as it is dry.

1234. In stripping larch bark, none is taken from the branches of the trees, but merely that from the stem; and in stripping it, the mell is seldom found necessary; but when cut into lengths upon the tree, it comes off easily with the chisel. It is more easily dried than the oak, and is treated in the same manner as the birch, being seldom put upon a stage, and is generally either carted off to the tanyard at once when dry, or preserved in stacks till sold.

1235. In stripping the bark from any of the trees mentioned, the best time is when the young leaves are expanding from the bud. The larch and birch generally strip about the 1st of May, and the oak about the middle or end of the same month, much depending upon the earliness or lateness of the season. Oak bark stripped after the 1st of July is never so valuable as that done during June.

1236. If wood is allowed to lie more than one day unstripped after being cut, it will not part with the bark so easily as when newly cut. The forester, therefore, should observe this point, and be careful not to allow one party to fall behind another so as to keep the wood lying for any time unstripped. Much of the quickness of getting through with the work will depend upon this. The more healthy any tree is, the more easily is the bark removed from it, and the earlier in the season will it be ready for stripping. An unhealthy tree never parts with its bark readily. Much of the success, therefore, in stripping wood will depend upon the healthy nature of the trees; and the unhealthiness of a tree may be known very easily by its being longer in coming into leaf than others of its own species which are in a healthy state.

1237. The larger that trees are when stripped, the greater is the quantity of bark that can be taken from them in a given time, so that the cheaper it is stripped per ton. We have got oak timber trees cut down and stripped of their bark at the rate of 30s. per ton for the bark produced from them; while, on the other hand, in cutting young coppice shoots, and stripping them of their bark, we have paid as high as 60s. for the work per ton of the bark produce, all when dried and ready for sale.

CHAPTER X.

SECTION I.—TREES BEST ADAPTED FOR GROWING TO USEFUL SIZE UPON LAND TERMED MOSS.

1238. As there is, both in Great Britain and Ireland, a large extent of waste land of the description termed moss, or *peat*, and as such tracts of land are not very susceptible of rapid improvement for agricultural purposes, it has now become a question of considerable interest among landed proprietors what sorts of forest trees will grow to most useful dimensions upon moss. This question has been very often put to me by extensive proprietors, whose woods I have been called upon to inspect, as well as by others who feel interested in the improvement of waste land, which has made me turn my attention more particularly to the gaining of information upon a point in forestry of so much importance. With this view I have visited a number of estates upon which plantations had been made upon moss land, and I am prepared to state the results of my observations, which may be useful to those who are projecting to plant such tracts.

1239. Moss or peat soil consists in general of decayed vegetable matter, which has accumulated in a flat or hollow part, having always a retentive bottom. In a state of nature, such moss is always full of water, which cannot escape downwards in consequence of the retentive nature of the stratum upon which it lies. The water contained in moss soil can escape only by evaporation from the surface; and from this it is evident that its surface must at all times be cold as compared with others lying upon an open or porous subsoil. It is also in consequence of this cold nature of moss land, in its natural state, that we never find any valuable or useful plants growing upon it, but only a few birch or alder trees, or it may be some heath or rough grasses. Moss land, even after being dried by draining, is found of a dull and inert character, and not apt to give life and energy to the growth of useful plants that may be put upon it. This is the more observable in such moss lands as are purely of a vegetable character, and without any considerable mixture of inorganic matter, such being generally known by the name of *flow* or *soapy* moss.

1240. In my investigations relative to the growth of trees in moss land I have found three different descriptions of this soil; namely, moss holding a portion of clay, moss holding a portion of sand, and moss of a purely vegetable character; and upon each of these I have found forest trees grow differently.

1241. In moss holding a portion of clay, any tree will attain to more useful and healthy dimensions than in either of the other two kinds, whatever the depth may be. In soil of this description, where it was from three to five feet deep, and resting upon a bed of clay, I have found very good and healthy oaks, poplars, willows, and spruce firs; in which case the soil had been well dried by open parallel drains nearly three feet deep. The plantation being nearly thirty-five years old, the poplars and willows were, at an average, about twelve inches diameter ten feet from the ground, and the spruce firs were about eight inches diameter at the same height; but the oaks, although apparently in a fair state of health, had not made proportionate progress, being on an average about six inches diameter six feet from the ground, and of a branchy habit. Many of the oaks were much larger; several of them nine inches in diameter; but the above was the average of them. In the same plantation, along one of its sides considerably exposed, I saw a few larch trees growing which had not attained to anything like a useful size, while they were also much covered with moss and of an unhealthy cast.

The plantation referred to was in a high-lying district in the north of England. In the immediate neighbourhood of it I found a considerable extent of ash coppice upon soil of the same description as the forementioned in a very healthy state, and in this ash coppice plantation there were a number of old trees of the same kind growing, which had been left as standards, but these were extremely unhealthy gnarled things. On first consideration, I thought that the unhealthiness in the case of the old ash trees might be accounted for from their having been often suddenly exposed by the cuttings of the coppice; but on further examination I found that even where they had had every advantage of shelter, they were unhealthy, and the wood of a short-grained nature. This at once pointed out to me, in a very forcible manner, that upon a moss soil, although ash will grow well in the form of coppice, it will not attain anything like valuable quality or dimensions as a timber tree. Again, having been called to inspect and report upon the condition of plantations on an estate in Berwickshire, I had an opportunity of seeing ash of a considerable age (nearly fifty years old) growing upon a soil of much the same nature as that above referred to. In this case also I found the trees unhealthy, being low and branchy in their habit, and the wood of a short-grained nature.

In the same plantation, however, I found the Scots pine in excellent health, and the timber apparently of good quality. From these and several other examples of like bearing I am led to say, and that with confidence, that poplar, willow, spruce fir, and Scots pine, will thrive well upon moss land containing a portion of clay—that is to say, where the land has been properly drained from all superfluous moisture; but oak will thrive indifferently, and ash badly, unless where these are kept in the state of coppice; and in such a state, from examples that I have seen, I am led to conclude that they will both succeed well. I may here state also, that upon the estate of Arniston I have cut down excellent oak timber from moss land about two feet deep, resting upon a bed of sandy clay, and also excellent larch timber under the same circumstances. This points out that, where the roots of trees, planted upon moss, can get down into a subsoil congenial to their nature, two feet of moss on the surface is little obstacle when properly dried.

1242. In moss soil, free from clay, but holding a portion of sand, trees do not grow so well as in a moss having an equal portion of clay. This I have verified from a number of observations made in the same manner as those referred to in the case of the soil containing clay. On the estate of Arniston there are several plantations upon what we term a sandy moss, not more than three feet deep. They consist generally of larch, Scots pine, and spruce fir; and I find that upon that soil the trees grow pretty quickly till they arrive at about thirty-five years of age, when both the larch and spruce begin to take heart-rot, while the Scots pines remain good.

Some hardwood trees are also doing moderately well upon the same soil, particularly the elm; and a number of birch trees which have been planted along with the others are thriving beautifully, and are evidently in their congenial soil.

1243. In the natural pine forests in Strathspey there are large tracts of moss land containing a considerable portion of sand, and when made dry by drainage, we find that the Scots pine attains no mean dimensions upon them. This is the case where the moss is very old, and of course well rotted and consolidated; but where it is of comparatively recent formation, and therefore not well rotted, we find that trees of no sort will grow on it; as when dried it is so open and porous as to admit of water passing through it at once, and therefore in summer to admit of the drought getting into it as readily. Under such circumstances no tree will prosper. From what I have stated in reference to moss land, it must therefore be understood that it is only on such as is of a well rotted character that trees will prosper.

1244. Relative to moss land of a purely vegetable character, I have seen at Scoon, in Perthshire, Scots pines growing well upon it, as also spruce fir and larch, for a time; but as soon as the two last mentioned sorts arrive at above thirty years old, they begin to decay in the heart, and consequently decrease in value. I have also seen oak of a pretty healthy character upon pure moss; but the wood of such trees is always found of very inferior quality. On the estate of Arniston there were oaks growing upon a pure vegetable moss, which were not in a vigorous state, but stunted and small of their age; and on soil of the same description we have seen on the same place spruce firs and willows of excellent healthy development; but as they were only about thirty years of age when I made these observations on them, I am not prepared to say how long their health may continue. From their appearance when I saw them, however, they promised to become of good size.

1245. I have of late seen very large enclosures planted on land of a purely vegetable character, and find that wherever it is of a well decomposed description, and has been well drained, the crop succeeds well, whether that be Scots pine or spruce fir; but generally speaking the crops on such land do not attain large dimensions, nor live to the usual age of the species as found growing on land more congenial to their nature.

1246. From the above statements relative to the growth of trees upon moss soil, it will appear that Scots pines and spruce firs, willows and birch, stand first in order as trees adapted for growing upon it to useful size. This statement must, however, be understood with the qualification, that if the situation be high and exposed, spruce firs and willows will not do well. Under such circumstances, Scots pines and birch would be more commendable, as being hardy and adapted for a high situation. It may be farther observed that the hardwood sorts, and more especially the ash, do not thrive well as timber trees upon moss land, but do well in the form of coppice. The quality, also, of hardwood timber grown upon moss land is very inferior as compared with the same sorts grown upon soil of a different description.

SECTION II.—CAUSE OF DISEASE AMONG LARCH PLANTATIONS.

1247. It is my opinion that there is no tree cultivated in Britain more worthy the attention of landed proprietors than the larch. There are very few purposes for which oak is now used, for which larch would not answer as well. It is a rapid-growing tree, and attains maturity long before the oak. I have seen larch trees, little more than thirty years old, sold for 60s. each, while oaks of the same age, and growing upon the same soil, in the same neighbourhood, were not worth 10s. each; and this at once points out the advantage of planting larch where immediate profit is the object. The larch has been held in high estimation in former times, as we learn from several old authors. The first mention made of the cultivation of this tree in England is by Parkinson, in his *Paradisus*, in 1629; and Evelyn, in 1664, mentions a larch tree of good size at Chelmsford, in Essex, It appears to have been introduced into Scotland by Lord Kames in 1734. But the merit of pointing out to the proprietors of Scotland the valuable properties of the larch as a timber tree for our climate, appears to be due to the Duke of Athol, who planted it at Dunkeld in 1741. The rapid growth of these, and of others of the same species, afterwards planted in succession by that nobleman, as well as the valuable properties of the timber of the trees that were felled, realised the high character previously bestowed upon the larch by foreign and British authors, who were followed in their opinion by others, such as Dr Anderson, Watson, Professor Martyn, Nicol, Pontz, Sang, and Monteith—all confirming, and further extolling, the valuable properties of the tree. It is no wonder, therefore, that the larch has been planted so extensively in Scotland of late years, in almost every kind of soil and situation, and under every variety of circumstances capable of being conceived in forest management, seeing that its culture has been so much recommended by men in whose opinions landed proprietors put much confidence as regards forest matters. I say that it is in a great measure owing to the advice of such men as I have above named, that the larch has been so extensively planted within the last sixty years in Scotland. According to their opinion, it was one of the hardiest, and most easy of culture, among our forest trees; and proprietors, relying too implicitly in this matter upon the soundness of these opinions, planted larch too indiscriminately upon all kinds of soil, without having due respect to the nature of the tree: for the larch, as well as every other tree, is influenced by a natural law, which restricts it to particular states of soil, in order to develop itself fully and perfectly; and from neglect of this the disease now so prevalent in the larch has originated. It is well known that, in many instances, whole plantations of larch trees have died—I may say almost suddenly; and in many instances, the return made by it has been far inferior even to the Scots pine.

1248. For some years past much has been said and written relative to the nature and cause of that disease, now so prevalent among our larch plantations, generally termed the *heart-rot*—or, as some writers term it, *dry-rot* (*merulius destructor*); but, despite all that has been written upon the subject, I am not aware that anything as yet really satisfactory has been the result, at least in so far as to cause any likelihood of a really permanent improvement in the cultivation of the tree for the future. I may, therefore, here be allowed to give my opinion as to the cause of a disease which appears still to prevail extensively among one of the most useful of our timber trees. Many who have written upon this most important subject assert that, from the circumstance of the larch not being a native, it is fast degenerating in our country; and, in illustration of their argument, they point out the healthy development of many old original specimens yet remaining in different parts of the country. Such an argument as this is scarcely worthy of being confuted; for we may as well say that the sycamore, which is not a native of Scotland, ought to be fast degenerating also, which we know is by no means the case. Another answer to this assertion is, that in many places we find healthy larch plantations, and in other places unhealthy, both, nevertheless, being of the same age. Now, if the larch is indeed degenerating, why is it found to succeed well in one place and not in another, and that, too, even within the bounds of the same gentleman's property? The only reasonable answer that can be given to this question is, that wherever the larch is found thriving well, it must be growing in a condition of soil and circumstances agreeable to its constitution; and wherever it is not thriving, these must be unfavourable to it. Therefore, in our further inquiries as to the cause of the rot in the larch, we must first ascertain the nature of the circumstances which affect the tree in both cases.

1249. The larch is a native of the south of Europe, and also of Siberia. It inhabits the slopes of mountainous districts, in the lower parts of which it attains its largest dimensions. In its native mountains, the larch is never found prospering in any situation where water can lodge in the ground in a stagnant state; nor is it ever found of large dimensions in any extensive level piece of country having a damp retentive bottom or subsoil. On the other hand, the larch, in its native localities, is found luxuriating upon a soil formed from the natural decomposition of rocks; for there the surface soil rests upon a half-decomposed stony subsoil, through which all moisture passes freely in its descent from the higher grounds. In this state of things, the roots of the trees always receive a regular supply of fresh and pure moisture, and, at the same time, the ground in which the trees grow is kept in a cleansed and wholesome state, not having any stagnated gas or water lodging in it; and this forms, in my opinion, the perfection of soil for the cultivation of the larch.

1250. On making some inquiries at a gentleman who had travelled among the mountainous districts in Germany, where the larch is found in its native state, I learned that, upon level and dry-lying parts of the region mentioned, the larch does not succeed well, being upon such parts always more stunted in its growth, and apparently not enduring so long, as when found with moisture passing freely among its roots. This is exactly in accordance with the state of our larch plantations in Scotland; for, wherever disease is found to prevail, there is either a want of or too much moisture in the soil.

Now, until on inquiry I was made aware of these circumstances relative to the larch as found in its native localities, I never could satisfy myself as to the cause of the disease which has so much prevailed among larch plantations; but since I have been made aware of the above circumstances, and have compared them with examples of healthy and unhealthy plantations on many estates where I have had the opportunity of examining for myself, I am now perfectly convinced as to the cause of the disease in question; and I am further convinced that any man who will compare the state of the land upon which a healthy plantation of larch is found (that is to say, one which has arrived at a considerable age, and is in a sound state), with what I have stated relative to the healthy state of trees of the same species as found in their native regions, will at once see the same circumstances acting in each case. Thus, in all cases of healthy larch plantations in this country, where the timber has attained large size, and is sound in quality, we find them growing upon a soil through which the water that may fall upon it can pass away freely; as, for instance, upon the slopes of hills, and even in hollows, upon a strong clay soil, but where there is a proper drainage for the ready and free passage of the superfluous water; and I have even cut down larch timber, of large size and sound in quality, growing upon a light sandy moss, two feet deep, which rested upon a stiff clay. In this case the moss was drained, and the water passed freely through the light soil; and the situation being upon a slope, there was a continual circulation of moisture passing along upon the top of the subsoil or clay. In short, I have found good larch timber growing upon almost all varieties of soil; but I never found it upon one which had not its particles constantly cleansed by the continual circulation of water passing through it, either by natural circumstances or artificial drainage. On the other hand, in all cases of diseased larch plantations, where the trees have become stunted and rotten in the hearts prematurely, we shall find that the soil has either been badly drained or not drained at all. There must be ingredients lodging in the soil which act against the health of larch trees growing upon it, and which can be carried off only by an effective system of drainage, in order to make it fit for the healthy rearing of this tree.

1251. In a plantation on a level piece of ground upon the estate of Arniston, I had occasion to cut down some larches in the way of thinning. The plantation was then about forty years old, and consisted of a mixture of larch and Scots pines. I found those which were cut in the central parts of this plantation, without exception, rotten in the heart, which was exactly what I anticipated, for the soil had never been drained; while some which were cut upon one side of the plantation that formed a sloping sandy bank, were found every tree sound, and of excellent quality of timber; and, at the same time, every tree in this position was at least three times as large as those planted in the interior level parts of the plantation, although all were of the same age. Now, the cause of the superiority of the trees which grew upon the sloping bank may at once be seen, from what I have already said upon the point. Again, another side of this plantation was bounded by a deep ditch, forming a fence upon the edge of a field; and all along this ditch upon the side of the wood, larch trees of excellent size and quality were growing. Nothing can be more convincing than this, that in order to grow larch timber of sound and good quality upon land which formerly grew diseased trees, all that is required is to drain it, when success will be the result.

1252. I have always found larch trees succeed better when growing among hardwood trees, than when growing by themselves or among pines, even although planted upon soil in the same state in both cases. The cause of this I conceive to be, that the roots of the hardwood, from their penetrating deeper into the earth than those of the larch, pine, or fir, have a tendency to divide the soil, and open it up for the more ready circulation of the water through it. It is, indeed, well known to almost every forester, that the roots of the hardwood trees will penetrate through the stiffest soil, and considerably break up and improve it to the depth of about two feet; and when the trees are of any considerable age, with their larger roots spreading far and wide, I have often seen the water running along the beds of such roots in considerable quantities, showing that they acted as conductors for the water through the soil. It is to this that I attribute the superior health of larch found growing among hardwood, as compared with those among their own natural order upon the same quality of ground.

1253. On the south lawn at Arniston House, there are about twenty larches yet growing, of very large dimensions. They are generally above eighty feet high, and a few of them contain upwards of a hundred cubic feet of timber; one in particular contains two hundred cubic feet, and is apparently in good health. The soil upon which these trees are growing, is a light sandy loam of about fifteen inches deep, resting upon a stratum of yellow sand. They are, as nearly as I could calculate from the appearance of one which was cut down, upwards of one hundred years old, and must have been among the first of the species planted in the lowlands of Scotland. These fine specimens are growing among hardwood trees as tall as themselves, but probably at least twenty years older. My opinion is, therefore, that the hardwood trees had been a considerable length before the larches were planted among them; and owing to this circumstance, the ground would be well prepared by the roots of the hardwood for the reception of the larches; which must, in a great measure, be the reason that most of our original specimens are the finest trees of the kind at present in the country—they having always been planted in favourable localities, and near the residence of the proprietors.

1254. From what I have said above, it will appear evident that the disease in the larch is chiefly attributable to the proper want of drainage of the soil. I have recovered a considerable extent of young larch plantations, which were fast going back, and that simply by draining the soil, in order to draw away from it superfluous water, as well as to cleanse it from bad qualities which were natural to it, and formerly prevented the healthy development of the larch tree. These young larch plantations were mostly under fifteen years of age when I drained them; but I cannot say if draining would recover plantations of older standing.

1255. In all cases where it is desirable to cultivate sound larch timber, the land should be drained with open cuts at from thirty to fifty feet, according to the nature of the soil, and not shallower at first than thirty inches deep; and as the plantation advances in age, the drains should be gradually deepened, and kept properly clean, and stagnant water never allowed to remain in them; for however well land may be drained at first, if the drains are not kept in a clean running state, they will ultimately be of very little benefit to the rearing of healthy larch.

1256. But besides the neglect of drainage, there is another cause of the diseased state in which a large extent of our larch plantations is found—viz. the neglect of thinning; for it is quite evident that, however well the land may be suited for the healthy development of this tree, if no proper attention be paid to give the crop proper space for the growth of each individual, disease must ensue as a natural consequence.

1257. Since the publication of the last edition of this book, I have examined a very large extent of larch plantations, both in England and Scotland, and, among others, those at Dunkeld, belonging to the Duke of Athole—and on few properties indeed have I found them attended to in this respect—and the result is, that the crops thus neglected are deteriorated accordingly.

1258. Generally speaking, I have observed that where the land is naturally, or has been artificially made, in a good condition for the larch, the trees grow healthily and well so long as they have proportionate space for the spread of their roots, and for that of their branches, and that when proper attention is paid to them in this respect, they never fail to become valuable as a crop; while, on the other hand, others planted in an equally good condition of soil, but which had not been attended to in the way of thinning, become diseased at a comparatively early stage; thus exemplifying that, in order to prevent disease in larch plantations, it is not only necessary to render the land wholesome by drainage, but also to thin judiciously as the crop advances.

1259. Not long since I was called on to give my opinion in regard to the woodlands upon a pretty extensive property, the greater part of which consisted of larch and oak. The estate was on a hilly district of the county, and the land was nearly all excellently adapted to the healthy development of the larch. I found that the larch portion of the plantations was from twenty-five to forty years of age, and that no regular or systematic system of thinning had ever been carried out. From this the trees were tall, drawn up, and a large proportion of them matured when only at forty years' growth. Neither the proprietor nor his forester could understand why this should be the case; when I explained to them that the cause of the prematurity of the crops was neglect of thinning. This I exemplified to them on the spot, from the circumstance of many trees in the different plantations having become large, and being in a healthy growing state, simply on account of their having accidentally had more space than their neighbours. In these woods I found the trees individually large or small, healthy or unhealthy, according to the space they occupied; there could, therefore, be no stronger proof that the cause of disease in larch plantations is neglect of thinning as well as of drainage; and that, in order to prevent disease in the subjects, both these operations must be judiciously attended to.

SECTION III.—EXTERNAL SYMPTOMS OF DISEASE IN TREES, AND GENERAL CAUSES OF THE SAME.

1260. Trees, like animals, are subject to various diseases, which, if not arrested by removing their causes, often either make them die suddenly, or retard their growth to such an extent that prematurity is speedily brought on. Disease in trees, like disease in animals, in all cases throws out external symptoms by which it can be detected; but in order to this the experienced eye is required. To the inexperienced, trees will often appear healthy, while in reality they may be the reverse. I have, in many instances where I have been called upon by proprietors to inspect their plantations, found them entertaining high expectations as to the future welfare of some favourite plantation, while I found it my duty to give them reports quite opposite to what they expected. I refer to this here, because I am well aware that plantations are often looked upon as being in a good state, while the contrary is the truth. Disease in trees, as in animals, is confined to no particular stage of their existence; from the sapling in the nursery-row to the full-grown tree in the forest, it may often be detected, causing premature decay in the subjects. Although this is a fact too often observable, and, I may say, too little attended to by professional men, yet, generally, trees are not apt to die either suddenly or prematurely when planted and existing under favourable circumstances as to soil and situation; and any failures which do take place, can, in most cases, be traced to the true cause, that being either in the nature of the soil, climate, or management of the cultivator. Moreover, trees, like animals, although they should grow up healthily and arrive at the most perfect state of maturity the soil and situation upon which they grow admit of, will begin to experience the gradual approaches of natural decay; the life principle of the trees will cease to act; and if not cut down before this stage arrives—which will, of course, be different according to the species and nature of the soil—they will, in the case of some soft-wooded trees at least, soon moulder into their original earth.

1261. The healthy development of trees, like that of animals, depends much upon the wholesome state of their food, and, at the same time, upon the want or excess of it; that is, if a plant, like an animal, receive too little food, its development will be irregular and stunted, and if too much of any particular ingredient, that excess must prove the parent of disease in its system, and of disease more fatal than the want of it altogether would have caused.

1262. Every tree in full health, and considerably under the age of maturity, produces annually an elongation of all its branches, and an increase in the diameter of its body proportionate to its species; and the external bark, more especially in the hardwood sorts, should be clean and smooth. The amount of the increase of growth in any given time is not, however, always a true criterion of its health. For example, I have often had occasion to remark, in cutting down trees, that one which was rotten in the heart, had made, up to the time of its being cut down, greater annual layers of young wood upon the stem, than another beside it which was perfectly sound and healthy. This will, no doubt, appear at first sight doubtful to the inexperienced, but it is, notwithstanding, the truth; and I merely refer to the circumstance in order to show that the increase in the annual layers of young wood upon the stem does not always indicate the true state of the tree. Even in such a case as this, however, there are always outward symptoms by which an experienced eye can pretty readily detect the inward rottenness: there is an indescribable something stamped upon the general bearing of the subject which betrays the hidden disease. Again, relative to this point, a tree upon an exposed situation may be making but small annual layers of young wood as compared with one of the same species in a sheltered part, and at the same time they may be both equally healthy; therefore, in judging aright of the health of any tree or plantation, the circumstances above mentioned must be taken into account. I said that the external bark of trees in full health should be clean and smooth; but relative to this also, caution is necessary ere we judge by the assertion simply as it stands. A tree may be in good health, and yet have the external bark somewhat coated with lichen and rough; for smooth and clean bark is more an attendant upon young trees in rapid growth than an indication of sound health, properly speaking. I could point out trees, having a clean and smooth bark, considerably damaged by inward disease; while, on the other hand, trees may be shown with a rough, mossy, and furrowed bark perfectly healthy and free from all disease; thus pointing out, that smooth bark is not altogether to be relied on in passing judgment on the state of a tree, but that other attendant circumstances must be taken into account. These statements may, to the inexperienced forester, appear contradictory, but such is often the case; and I merely advert to them to show, that any single mark of either disease or health is not in all cases to be relied on; for the apparent marks of both health and disease may exist on the same patient at the same time; and it may even require a close investigation from the most experienced of either foresters or vegetable physiologists before deciding as to its state. Having thus premised, it is not my intention here to enter into details regarding, or even to refer to, all the diseases to which trees are liable in our climate. This would of itself be matter for more than one volume of ordinary dimensions; it is, in fact, more a subject of vegetable physiology than one belonging to such a work as the present, which is, strictly speaking, a plain practical work on the rearing of forest trees. It is, however, necessary that I should here advert a little to such diseases in forest trees as are generally the offspring of bad management in the forester; and, accordingly, I shall point out the external symptoms of such diseases, the general causes of the same, the means of cure most likely to succeed where the trees are infected, and those of prevention where no disease may have yet appeared.

1263. The principal diseases likely to be brought on forest trees by bad management are—1st, *Bark-bound;* 2d, *Moss or lichen upon the bark;* 3d, *Stag-horn tops;* 4th, *Scale;* 5th, *Premature bearing of seed;* 6th, *Dropsy;* 7th, *Ulcers;* 8th, *Wounds;* 9th, *Stunted growth of the young wood.*

1264. Any of the above-mentioned diseases may, to a considerable extent, be brought on trees by mismanagement in their cultivation; and with regard to the first mentioned—namely, *bark-bound,* it may very frequently be found to exist on hardwood trees in any soil or situation where they may have been injudiciously managed, either in the way of planting, pruning, or thinning. The external appearance of a tree in the state termed *bark-bound,* may be thus stated: outer bark hard and compressed, and of a dry coriaceous texture; the stem of the tree, as also the larger branches, with young shoots springing out immediately from the bark, at irregular intervals. When the disease is not of long standing upon a tree, if a longitudinal incision with a knife be made in the summer in the outer bark, it will immediately contract upon each side of the incision, leaving the cut much wider than the instrument could make in the case of a healthy tree; but if the disease be of long standing, this contraction of the bark will not take place, at once indicating that the wood of the tree and its bark adhere so closely together, that the sap cannot flow between them. Another symptom of this disease in a tree is, that the proper lateral and top branches make small and weak annual shoots; and each year, as the disease becomes more confirmed, the annual shoots become the more weakly. The cause of this disease, as its name expresses, is the bark being *bound* or girded about the wood of the tree, thereby preventing the free flow of the proper sap from the roots to the leaves, and also arresting the descent of proper woody matter between the wood and the bark. In this case, if the cause of the disease be not removed in proper time, the vital fluids become gradually checked, till at last the passages become entirely closed, and, as the natural consequence, the plant dies.

1265. I have already stated that "bark-bound" may be caused by injudicious planting, pruning, or thinning. As caused by injudicious planting, we have often occasion to witness it when any tree is planted in an unsuitable soil, and on a situation too high and exposed for its healthy development. For example, the spruce fir or the ash, in all cases where they are found planted in a light soil and upon an exposed and high part of the country, more particularly if growing upon the outside of a plantation, will be found of a short bushy habit, having their bark hard, and adhering to the wood, and scarcely showing any symptoms of vitality till far on in summer. In this state the trees are bark-bound, which disease is caused by the vital fluids being not strong enough to resist the cold and drying influences of the atmosphere; and in such circumstances the trees seldom assume anything like a respectable size. As to recovery in a case of this nature, I have never been able to see how that could be effected: we may as well say that a geranium, which may have been planted in an improper soil and on an exposed site, should be made to grow as well as one in a sheltered part. Of course, all that is required is a change of soil and protection ; but this would be impracticable with regard to a spruce fir or an ash under such circumstances. The fault rests with the planter ; for, in fact, the trees so situated, according to their nature, are not in a state of soil and air adapted for their healthy growth : premature death must therefore be the result. The same results will follow in the case of any other kind of trees that may be planted upon a soil too poor, and on a situation too exposed for their health ; and the disease, under those circumstances, is incurable—at once showing the evil and ruinous effects of planting trees in a situation not adapted for them.

1266. As caused by injudicious pruning, I have often witnessed this disease to a fearful extent, even where formerly the trees were in excellent state. Trees that may receive a severe pruning of their larger branches, more particularly if they are in a plantation which has been severely thinned at the same time, are almost certain to become bark-bound, however healthy they may have been before that operation was performed upon them. In this case the disease is caused by the severe denuding of the trees of their branches, the subjects being rendered weakly from want of leaves to elaborate their sap, and from the atmosphere being thereby cooled down suddenly about them ; and the only rational remedy under such circumstances is, to allow the trees to regain their former shelter as nearly as possible, and afterwards to prune and thin more carefully. Trees under such circumstances, if under thirty years of age, are very likely gradually to recover, although they will never afterwards attain such valuable size as they would have done had they received no check from such disease ; but if the trees are much above that age, they are not likely ever to recover, at least so far as to become valuable as timber.

1267. The results are much the same with regard to the disease, as it is often caused by injudicious thinning. When the atmosphere of the plantation is suddenly cooled down by a severe thinning, the sap is retarded in its ascent, and expended in keeping up the life principle of the tree. The consequence is, that little woody matter is returned from the leaves, the bark gradually becomes dry, and the trees, if they do recover, do so slowly, and never afterwards reach the value they would have attained, had they been properly dealt with. Trees, although injured by severe pruning and thinning, as above stated, may, notwithstanding, be in a great measure recovered, and that by two methods—namely, by removing the diseased outer bark from the tree, or by softening the bark by means of any moist substance.

1268. In attempting the recovery of bark-bound trees by removing the outer bark, it is only necessary to have this chipped or scraped off by means of any moderately sharp iron instrument. If the trees to be operated upon are young, with a thin smooth bark, care must be taken to scrape only; but if the trees be pretty old, with a rough thick coat of outer bark, it must be chipped off. I have frequently seen an old hedge-knife used for this purpose, and that with great effect. In removing the outer bark, the operator must be careful not to injure the soft inner bark next the proper wood. I consider the month of April to be the best season of the year for performing this operation on trees. The foregoing method is frequently practised for the purpose of recovering trees diseased in the bark, but it is not nearly so effectual in bringing about a thorough cure as that of softening the diseased outer bark by means of some moist substance applied to it. Therefore, to those who may find it necessary to apply a remedy for recovering bark-bound trees, I would recommend them to proceed thus: Have a quantity of good moss gathered from the woods, or from an old grass field, of the same description as is commonly used by nurserymen for packing, and have it well incorporated with nearly an equal bulk of fresh cow-dung, making the mixture form a complete plaster. With this cover the bark all over the stem of the tree affected, as also part of the larger branches, to the thickness of about one inch; and in order to keep this plaster on, have the whole wound round with ordinary hay or straw ropes. If this be applied in the autumn, and allowed to remain till the May following, the bark will be completely softened and in a pliable state; but in order that it may not receive any sudden check from the influence of the weather after the plaster has been removed, it is advisable to have the whole wound round again with fresh hay-ropes, these being allowed to remain till they become wasted and naturally fall off, when a complete cure will be found effected. In dry weather, it will be an advantage to syringe with water the ropes upon the trees, which will tend to keep the bark in a healthy soft state.

1269. With regard to the second mentioned external symptom of unhealthiness in trees—namely, *moss or lichen upon the bark*—this may be found to exist upon trees in a variety of circumstances, soils, and situations, and is not always a symptom of unhealthiness. In any district of country where much rain falls, almost all trees will, to a certain extent, be found infested with lichen; and, notwithstanding, the trees may grow vigorously and be found in good state, as I have frequently witnessed. Trees existing in a damp humid atmosphere, where they have not a free circulation of air about them, are generally much overgrown with moss upon their stems. In this case a diseased state of the trees cannot be said to be the cause of the moss growing upon them; but such trees, existing in a state of air favourable to the development of the lichen seeds upon their bark, may be ultimately much injured by the plants excluding light and air from the bark; and, in this case, draining of the soil, so as to carry off all superfluous moisture, thinning the trees judiciously, so as to admit a free current of air, and removing the lichen from the bark, will generally completely restore them. But if those requisites of health have been too long neglected, it will be impossible to effect a cure. Trees existing in a high and exposed situation, more especially if the subsoil upon which they are growing is cold and damp, are almost always much infested by both moss and lichen. In such circumstances, this is caused by the languid state of the juices of the trees, and their not being, as it were, sufficiently strong to resist a degree of decomposition in the outer bark. In a case of this nature, the only remedy is to have the subsoil made wholesome for the roots of the trees by draining, and to preserve shelter as much as possible, by not over-thinning or unduly exposing the trees.

1270. Again, any plantation which may have stood for a considerable time in a confined state for want of thinning may, after receiving a severe and injudicious thinning, become unhealthy in the outer bark; and, as a certain natural consequence, the trees will be much overgrown with lichen. In this case, the cause of this growth is the sudden exposure of the trees rendering the bark diseased. I have frequently seen this take place where bad management prevailed; and after the trees had grown more closely together, so as to produce shelter throughout, the lichen disappeared. We thus see that the appearance of lichen upon the bark of trees is not always a symptom of decided disease in them, but may be occasioned by a temporary derangement in the natural functions of the outer bark; and if observed in time, like any other disease, may be arrested by removing the cause before it has had time to become decidedly fixed in the constitution of the trees affected.

1271. What has been said relative to the appearance of moss and lichen upon trees, is principally applicable to the hardwood sorts. As to lichen affecting the pine and fir tribes, I shall speak of that shortly. In the mean time, I would remark here that hardwood trees generally are more easily cured of any disease than pines or firs are; the reason appearing to be, that their juices are more pliant than those of the others. The juices of the pines and firs are of a thick consistency, and any sudden check to the life principle of those trees at once stagnates their juices and renders them unfit for circulation; whereas, in the case of the hardwood sorts—such as the oak, ash, &c.—the juices are thin and of a watery consistency; and although those trees may receive an injury in their constitution, these juices will continue to flow to a certain extent, and thus keep up the life of the tree; and, as the cause of disease gradually subsides, they will regain their former strength.

1272. Almost all trees growing in high districts, unless the soil be favourable, are less or more infested by lichen, which is occasioned, I think, by the want of a full flow of sap in the trees to keep the bark in a soft moist state. The bark of all such trees, when they have arrived at any considerable size and age, is found dry and hard, and, as it were, in a half-decomposed state—thus becoming a favourable receptacle for the growth of the seeds of lichens; yet the trees, under these circumstances, may be healthy enough in their constitution. It must, however, be admitted, that, under such circumstances, trees cannot grow vigorously or attain the valuable size they would do under more favourable circumstances. In all such cases, therefore, it would be a very great improvement to scrape off this outer diseased bark, and thus remove the lichen and allow the stems of the trees to expand more freely by the influence of light and heat penetrating more readily through the bark. On the other hand, almost all trees growing upon a sheltered district of country—unless, indeed, where the soil may be unfavourable to their growth—are generally found clean and free from either moss or lichen; the reason of which appears to me, that the trees, growing in favourable circumstances of soil and situation, have a vigorous constitution, with a full flow of sap, which keeps all their parts in a healthy state, so that no opportunity is afforded to the seeds of such plants harbouring on them.

1273. From what has been said above, it will appear plain that, where moss or lichen exists upon trees, it is in general a symptom of something wrong, although not always a symptom of decided disease, but possibly occasioned by some temporary derangement in the functions of the bark. The only way to prevent this appearance, is to keep the soil dry, to admit a free circulation of air, and not to give any sudden check to the bark by over-thinning.

1274. With regard, however, to lichen growing upon the bark of the larch, fir, and pine tribes, and where it is retained upon them without intermission the whole year, the case is very different. In these it is a certain indication of decomposition in the heartwood of the trees affected by it. In all my surveying of plantations in both England and Scotland, during the last ten years, I have seldom been deceived in pronouncing, relative to larch, pine, and fir trees, whether they were in a healthy or unhealthy state, and that by the appearance of the lichen and moss upon their bark alone. In doing this, however, there is an indescribable something which I am guided by in my own mind, and which I could not here explain for the guidance of others; it is, in short, a mere tact of observation combined with experience, which is inexpressible upon paper. I may say thus far, that wherever the lichen is found to extend about two-thirds up the entire height of the stem of a tree, and is also spreading out upon the branches, and not falling off during the summer, decomposition in the heartwood is evidently going on. Such trees should at once be cut down, as the longer they stand they will become of the less value. There is also something to be founded on from the appearance and kinds of the lichens and mosses at different stages of disease; but this can only be explained by close observation upon the subjects.

1275. The *third* external symptom of disease in trees is stag-horn top. This symptom is one easily distinguished from all others by the top and upper branches of the tree affected becoming dead and quite bare of all leaves and young twigs, having the appearance of stags' horns. This disease may be occasioned by dampness in the subsoil in the case of some sorts of trees, and by the want of sufficient moisture in that of others. It is generally preceded by one, and sometimes by both of the symptoms already mentioned, and is, I may say, in all cases, irrecoverable, except by draining and pollarding, by which means the tree affected may indeed be made to lengthen out its existence, but not to regain its former healthy constitution. Willows and poplars, which luxuriate in a soil rather damp than otherwise, generally become stag-horn-topped when grown in a soil too dry for their healthy development, and that as soon as they have arrived at such maturity upon the soil upon which they may be growing, as its nature is capable of bringing them to. It at once indicates their premature state; and the wisest thing is to cut them down, seeing the soil is not adapted for their growth. Elm, oak, ash, plane, &c., generally become stag-horn-topped when the soil in which they may be growing is too damp for maintaining them in a healthy state; and, in this case, if the disease be observed in time, draining the soil, and cutting off the parts affected, may produce a cure; but if the subject is old, and the disease has made considerable progress, it is seldom that recovery can be secured, at least so fully that the tree can ever become a valuable and healthy one.

1276. The *fourth* external symptom of disease in trees is *scale*, which is a small white insect found clinging to the bark of some species. In forest trees it is most frequently found upon the ash while in a young state. This insect, like lichen, is indicative of a constringent state of the bark, and may be often found upon the bark of young ash-trees which have received an injudicious and too sudden thinning. I have also often seen it to a very great degree on ash trees growing upon a light gravelly soil, which is not congenial to their healthy growth. This latter case at once points out that the constitution of the trees affected under such circumstances is impaired, and that they will not succeed to anything worth, whatever means may be used for their recovery. Where it is evident that trees with scale upon them have been injured by a too severe thinning, the case is very different. These may be recovered by scraping off the outer bark with the scale, and allowing the trees in future to become more close among one another, so as to produce shelter sufficient for their health, as was recommended for bark-bound trees. The scale is easily distinguished by the appearance of the insect upon the surface of the bark. It presents itself as very numerous small white spots, like those on the bark of the birch; and if the observer take a stone and draw it roughly along the tree, he will kill many of the insects, and see their blood give a red tinge to the bark.

1277. The *fifth* external symptom of disease in trees is premature bearing of seed. No tree, in a healthy rapid-growing state, is ever found to produce seed till it has arrived at a considerable age and size. I would say that any forest tree bearing much seed under forty years of age is not likely, ultimately, to arrive at anything approaching a valuable size. Any tree, however healthy a state it may be in, may be made to bear seed, simply by mutilating its roots, or by pulling it over; thus at once showing us that, before a young tree produces seed, it must be brought into an unhealthy state, either naturally or artificially. Being aware of this, it will at once be evident that, when we find a young tree producing profusion of seed, there can be no doubt but that it is in a state of premature decay; therefore, in all such cases we may be at once assured that such trees will not become valuable as timber. In short, when found under those circumstances, disease must have been going on for a considerable length of time, and I am not aware of any successful means that could be applied for their recovery. The premature bearing of seed in the larch, I have in all cases found to be a sure index of heart-rot in the trees; and even in the case of pines of any kind, the bearing of seed in their young state at once points out a weakness in their constitution, and tells, to the observing eye, that the trees never will become valuable as timber, but that they will become decayed in the heart long before they can arrive at large dimensions.

1278. The *sixth* symptom of disease in trees is dropsy. This disease most generally takes place in forest trees, either where the soil is too rich for them, or where there is an excess of moisture about their roots. The cause of it appears to be that the roots take into the system of the tree an excess of juices, which the bark and leaves cannot assimilate. In this disease, unnatural swellings are observable on some parts of the stem, which begin to rot and throw off the bark. It often also happens that the leaves will be found dropping off in their green state, and then the tree will be found to die suddenly. I have frequently seen this the case with the oak, where planted in a very rich soil with abundance of moisture. In this disease, where the bark becomes detached from the wood, there will be found a reddish-coloured water between the wood and the inner bark. I consider it incurable; and the only thing is to prevent it by attention to the ground being well drained and not over-rich.

1279. *Seventh,* Ulcers. This is a disease in trees which very much resembles the last; but it is mostly confined to the larch and pine tribes. Its appearance is that of a running sore upon the side of the stem, where the natural juices escape in the form of a hard resinous matter. This disease is mostly found upon young trees of these tribes, and is occasioned by insects lodging their eggs in the inner bark, where the young live for a time, and destroy the alburnum. I have frequently observed this disease take place in young larch plantations, where the soil was in a condition unfavourable to their growth.

1280. *Eighth,* Wounds. It sometimes happens that trees will receive damage on their stems by having the bark peeled off by accident in some way or other, which may prove injurious to their health, and not unfrequently be the cause of death. Any tree in a healthy state is not easily injured by any external wound upon the bark, unless, indeed, that be so extensive as completely to strip the tree of its bark all round at any given part, as is frequently observable in the case of cattle stripping the bark off to a considerable extent, when, of course, a tree must be much injured, and will gradually decline in health, and ultimately die. But this is an exception to wounds of a general nature; and any simple damage received upon the bark of a healthy tree in all cases soon heals up, and is only of a temporary nature. The case, however, is very different with an unhealthy tree which may receive an apparently simple wound, such as a piece of the bark, or even a large branch broken off. In a case of this nature, when the sap of the tree injured is in a diseased state previously, the wound made becomes, as it were, a running sore; rot will sometimes be induced at the part, and a gradual decaying of the whole tree will take place. This state of a wound in a tree does not often occur; but I have known it to take place, and that in trees which were in a state of dropsy. As I have already said, however, any simple wound made upon a healthy tree is seldom or never found injurious, but soon heals up.

1281. *Ninth,* Stunted growth of the young wood. This state of a tree is at once apparent by the very short annual growth of young wood upon all the lateral branches; and may be in general the natural result of any of the diseases already described. Every healthy tree in a fair growing state, if not arrived at natural maturity, ought to make annual growths of new wood, upon the lateral and top branches, of from six to thirty inches, according to age and species. If, however, a tree of thirty years of age make shoots of twelve inches annually, and soon after that period is found to be making shoots of four inches only, there is reason to suspect that it has become suddenly unhealthy. The cause must be sought for in some one or other of the diseases already mentioned, and a remedy applied accordingly.

Every tree when it has attained the full size and development of its nature, however healthy it may have hitherto been, gradually begins to fail in making young wood. This is the work of time, doing to the old tree what disease does to the young.

1282. There is very little danger indeed of trees being destroyed by disease, provided they are planted upon a soil properly fitted to their nature. This, generally speaking, it is in the power of the intelligent forester to accomplish, by drainage, in the first place, and by a judicious selection and adaptation of the different kinds to the different descriptions of land; and not less important is a judicious application of systematic thinning afterwards.

SECTION IV.—THE PERIODICAL INCREASE OF TIMBER IN THE DIFFERENT SPECIES OF FOREST TREES.

1283. There is no part of a forester's education more neglected than that of having, as far as possible, a thorough knowledge of the size that trees ought to be, on a given soil and situation, at a given age. Such a knowledge can only be obtained by close observation, and by extensive experience. For some years past, having been largely employed in the surveying and valuing of plantations, both in England and Scotland, and seeing that there was great want of data upon which to calculate prospectively the future value of plantations, I have applied myself particularly to gain information upon this point, which I shall, in the present section, lay down for the guidance of others who may be called upon to act as valuators of wood. For a number of years past, I have made it a point of duty, wherever I have been called upon to examine plantations, to take notes of the different sizes of trees as I found them to exist at a given age on a given situation; and having examined plantations of many kinds, upon a great variety of soils and situations, as well as under many descriptions of management, I have come to the conclusion, that the size of a tree at a given age, upon a given situation, does not depend so much upon natural circumstances as upon the artificial management it may have received. In illustration of this, I may mention that I have surveyed plantations in England which were growing upon a very favourable soil and situation, and which, compared with others of a like age in the north of Scotland on a soil rather unfavourable, were, notwithstanding, far inferior to the latter; this being occasioned by bad management in the one case, and good in the other. From such a case we may see that the cultivator of wood, as of any other product of the soil, has much in his power in making the crop profitable or not, even where natural circumstances may seem unfavourable.

1284. It would be impossible here to give the size which trees ought to attain on every variety of soil and situation, and under all circumstances of management—so much depending upon both artificial and natural local circumstances. For example, I have frequently seen a plantation of trees, which had been growing at a rapid rate, and making great progress in diameter of wood, suddenly checked in health by an over-thinning, and afterwards, in consequence, making but little progress; while, on the other hand, I have as frequently seen the trees in a plantation, which had been for a time in a confined state, and had been in consequence doing little, after being judiciously thinned, rapidly enlarge the diameter of their stems. Again, with regard to natural local circumstances, I have often observed trees growing on a situation much sheltered by older wood, &c., making great progress in the laying on of diameter of wood; while in another plantation not far distant, and upon the same description of soil and altitude, and under the same system of management as the other, but much more exposed to the free influence of the natural climate, trees of the same sort were making comparatively little advance. Now, on taking into account all those varied circumstances which affect the growth of trees, it will at once be evident, that to say such a kind of tree should, at a given age, and upon a given situation, be an exact given diameter, is a degree of perfection not to be arrived at, at least during the present century. In giving, therefore, my calculations in the present section, as to the periodical increase of timber in trees, I beg to be understood that these are given as an average of what ought to be the result at certain ages, and under fair circumstances of situation and management.

1285. In taking my calculations of this periodical increase of timber, I have invariably measured the trees at about eight feet from the ground; and, for the sake of better illustration, I have reduced my calculations to three distinct bases of situation. The First is an average of the periodical increase of timber in trees growing on a favourable soil and site; the Second, of that increase in trees growing on moderately favourable ones; and the Third is an average of the growth of trees growing on unfavourable ones.

1286. Having premised the above, I shall now give the periodical increase of the oak.

AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET FROM THE GROUND.		
	1st. On favourable Soil and Site.	2d. On moderately favourable Soil and Site.	3d. On unfavourable Soil and Site.
Oak at 10 years old, . .	½	¼	...
... 20	4½	3	2
... 30	9½	7	4½
... 40	16	12½	8
... 50	20½	16	9
... 60	25½	18	10
... 70	29	19½	11
... 80	31½	20½	11½
... 90	32¾	21½	...
... 100	33½	22	...
... 120	34¾	...	...

1287. The foregoing statements relative to the oak have all been taken in cutting down timber at all the different ages specified; and the numbers given under each head are the averages taken from many trees of the same age. The most prominent feature of the statement is, that upon the favourable soil and situation, as stated under the 1st division, the oak not only grows more rapidly and attains a greater diameter of wood in a given number of years, but it also continues to grow healthily, and lay on a greater bulk of wood at a great age, than the others on less favourable soils and situations; that is, taking the oak upon a favourable soil and site, at from ninety to one hundred years of age, we will invariably find it make considerable progress during that period; while the same sort of trees, as found growing upon a less favourable soil and site, will have almost ceased to make any perceptible amount of timber. Between ninety and one hundred and twenty years of age, the tree, in the former case, has increased its diameter to the extent of two inches; while in the latter, one half inch is made during that period of thirty years;—and again, in the third case specified, no increase has been made at all; and at this stage the wood of such a tree must be in a declining state. We thus see that, on an unfavourable soil and site, if we wish to have the wood in its most valuable state, it should be cut between sixty and seventy years of age, and on the moderately favourable soil between eighty and ninety; while upon the favourable soil it may be left growing till perhaps one hundred and forty or one hundred and fifty years. At first sight it may appear that two inches in diameter is but a small amount of wood to be laid on by a tree during a period of thirty years, as in the case of the oak in the 1st class between ninety and one hundred and twenty years. But if we suppose the stem of such a tree to be twenty feet long only, we will have laid on during that period at least fourteen feet of extra timber, which, at 3s. per foot, gives £2, 2s. of additional value in wood laid on.

1288. I shall now proceed with a corresponding statement relative to the larch; but, instead of giving the diameter at periods of ten years, as in the case of the oak, I shall take periods of five years. My reason for doing so is that, in cutting down larch trees, their periodical thinnings are generally made at or within periods of five years; consequently it is an object of importance to have an estimate of the diameter which they should, in general cases, present at periods of five years.

AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET FROM THE GROUND.		
	1st. On favourable Soil and Site.	2d. On moderately favourable Soil and Site.	3d. On unfavourable Soil and Site.
Larch at 10 years old, .	1½	½	...
... 15	5	3	2
... 20	9	7	5
... 25	11	9	6
... 30	13½	11	7½
... 35	17	13½	8
... 40	21	15½	...
... 45	23½	16½	...
... 50	24½	17	..
... 55	25½	17½	...
... 60	27	18	...
... 65	28	...	...
... 70	29	...	...
... 75	30	...	...
... 80	30½	...	...

All those measurements are taken from trees cut down upon the estate of Arniston. They indicate to us that, on a favourable soil and site, the larch will continue to make wood till above eighty years of age, and will even then be of a sound constitution, as I have frequently had occasion to observe; while, on a soil of moderate capabilities, sixty years of age may be considered as the maximum of the larch; and in order to have the full value of the trees growing under such circumstances, they should then be cut down. Again, upon a soil and situation unfavourable, from thirty to thirty-five years may be considered as the maximum of the trees; and if not cut down at that age, the trees will begin to decay rapidly in the heart-wood.

1289. I shall next give a statement of the progressive growth of the

Scots pine, as taken from specimens of the tree measured in the Highlands of Scotland, as well as others on the estate of Arniston.

AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET ABOVE THE GROUND.		
	1st. On favourable Soil and Site.	2d. On moderately favourable Soil and Site.	3d. On unfavourable Soil and Site.
Scots pine at 10 years old,	1	¾	...
... 15 ...	4	3	½
... 20 ...	6½	4½	2½
... 25 ...	9	6	4
... 30 ...	11	7½	5½
... 35 ...	12½	9	6
... 40 ...	14	10½	6½
... 45 ...	15½	12	7
... 50 ...	17	13½	7¼
... 55 ...	18½	14½	...
... 60 ...	19½	15½	...
... 65 ...	20½	16½	...
... 70 ...	21½	17	...
... 75 ...	22	17½	...
... 80 ...	22½	18	...
... 85 ...	23¼	...	...
... 90 ...	24	...	...
... 95 ...	24½	...	...

1290. The following represents the periodical increase of timber in the spruce fir, as taken from an average of trees measured on a number of estates in Mid-Lothian:—

AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET ABOVE THE GROUND.		
	1st. On favourable Soil and Site.	2d. On moderately favourable Soil and Site.	3d. On unfavourable Soil and Site.
Spruce fir at 10 years old,	2	1	...
... 15 ...	5	3	1⅓
... 20 ...	7	5½	3¼
... 25 ...	10	8	4⅓
... 30 ...	13½	11	5½
... 35 ...	15	13	6
... 40 ...	17½	15	...
... 45 ...	18¾	16	...
... 50 ...	20	17½	...
... 55 ...	21¼	18	...
... 60 ...	22¾	18¼	...
... 65 ...	23½	18¾	...
... 70 ...	24½	19	...
... 75 ...	25½	...	...
... 80 ...	26¼	...	...
... 85 ...	27	...	...
... 90 ...	27¾	...	...

The measurements in the 1st class of spruce firs, as above stated, were taken from trees generally growing in hollow sheltered parts upon a stiff heavy clay of a damp tenacious nature; and those in the 2d, from trees generally growing upon a fair loamy soil on flat parts of the country, well drained. Those in the 3d class, being upon unfavourable soil and situation, have all been taken from the average of trees found growing upon a thin gravelly soil with a high exposure, under which circumstances the spruce seldom arrives at any useful size, generally taking heart-rot when from thirty to thirty-five years of age, and then failing to make wood, as indicated in the table.

1291. The following statements show the periodical increase in the ash and sycamore, taken from measurements of trees cut down on the estate of Arniston, as well as upon some other estates in Mid-Lothian—all which were, I consider, growing under moderately favourable circumstances of soil and situation. Not having got measurements upon 1st or 3d class ash and sycamore trees, I must in the mean time restrict myself with regard to these trees, to the average of 2d class ones.

AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET ABOVE THE GROUND.		AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET ABOVE THE GROUND.	
	The Sycamore, on a moderately favourable Soil and Site.	The Ash, on a moderately favourable Soil and Site.		The Sycamore, on a moderately favourable Soil and Site.	The Ash, on a moderately favourable Soil and Site.
At 10 years old,	2	1½	At 70 years old,	22½	24
... 20 ...	5½	4½	... 75 ...	23½	26
... 30 ...	9½	7	... 80 ...	25½	28
... 35 ...	11½	9	... 85 ...	27½	30
... 40 ...	13	10½	... 90 ...	29	31½
... 45 ...	15	12	... 95 ...	30	33
... 50 ...	16½	14½	... 100 ...	31½	34
... 55 ...	18	17	... 105 ...	33	34½
... 60 ...	19½	19½	... 110 ...	34	...
... 65 ...	21	22			

1292. I shall now give a statement of the periodical increase of timber in the Scots elm and the black poplar. The elm is an average of trees growing upon a moderately favourable soil and situation, and the poplar of those raised in a very favourable one. As yet I have not had leisure to devote such time to the subject as to enable me to furnish data to give statements of the 1st and 3d class trees of the elm, or of the 2d and 3d of the poplar. In the mean time, therefore, I defer giving any more than the following, hoping that still it may be in my power to supply those particulars which are now left blank.

AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET ABOVE THE GROUND.		AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET ABOVE THE GROUND.	
	Black Poplar, on a favourable Soil and Site.	The Scots Elm, on a moderately favourable Soil and Site.		Plack Poplar, on a favourable Soil and Site.	The Scots Elm, on a moderately favourable Soil and Site.
At 10 years old,	5	1½	At 55 years old,	40	19
... 15 ...	9	4	... 60 ...	...	21
... 20 ...	15	6	... 65 ...	...	22½
... 25 ...	21	8½	... 70 ...	...	23½
... 30 ...	26	10	... 75 ...	...	24½
... 35 ...	29½	12½	... 80 ...	...	25½
... 40 ...	32	14½	... 85 ...	...	26
... 45 ...	36	16	... 90 ...	...	27
... 50 ...	38½	17½	... 100 ...	...	28

1293. I now give the beech and sweet chestnut, as taken from the average of a number of trees cut down on various estates in Mid-Lothian, on moderately favourable soils and situations.

AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET ABOVE THE GROUND.		AGES OF TREES.	DIAMETER IN INCHES EIGHT FEET ABOVE THE GROUND.	
	Sweet Chestnut, on a moderately favourable Soil and Site.	Beech, on a moderately favourable Soil and Site.		Sweet Chestnut, on a moderately favourable Soil and Site.	Beech, on a moderately favourable Soil and Site.
At 10 years old,	2½	2	At 50 years old,	15	21
... 15 ...	4½	4	... 55 ...	16½	22½
... 20 ...	7	6½	... 60 ...	17½	24
... 25 ...	8½	9	... 65 ...	19	25½
... 30 ...	10	10½	... 70 ...	20	27½
... 35 ...	11½	15	... 75 ...	21	28½
... 40 ...	13½	17	... 80 ...	22	29
... 45 ...	14½	19½	... 85 ...	22½	30½

From the two statements given above relative to the periodical increase of timber in the sweet chestnut and the beech, it is very observable that, on a soil of moderate capabilities, the beech grows to a much larger size than the sweet chestnut; showing that, in order to bring the sweet chestnut to the large dimensions which we find in some parts of the country, it requires a very favourable soil and situation—a point of great importance to be kept in view by any person engaged in valuing wood for the transfer of property.

1294. Having now given the foregoing statements relative to the periodical growth of our principal forest trees, in so far as my observations on the subject will at present permit me to do in a decided manner, I shall only state, in conclusion upon this point, that I have found these calculations of the greatest value to myself when called out to value plantations prospectively for the transfer of landed property; and I have no doubt but that they will also prove of value to others. There is great want of a far more extensive basis upon which to calculate the progressive growth of trees than is here given, and it would be of infinite advantage to all interested in timber growing, were every intelligent forester to turn his attention to this point, and lay up, at least for himself, from his own experience, as extensive data as possible relative to the periodical increase in the growth of timber on the estate upon which he may be employed.

1295. Before concluding the present section, it may not be out of place to answer a question which has been very frequently put to me by proprietors of plantations—namely, what height should a tree of a given species be at a given age? My answer is, that under equal circumstances of soil, management, and situation, trees of any species will, at a given age, be pretty nearly a given height, but may, under different circumstances of soil, &c., greatly vary in height. Thus, if we suppose that an oak tree at forty years of age should be as many feet in height, when growing on a level and moderately sheltered part of the country, it is quite likely that another oak of the same age, if planted on a high and exposed situation, will not be much more than twenty feet high; and again, another oak of equal age, planted in a sheltered glen, may attain the height of sixty feet in the same number of years; thus showing us that, in this respect, as in the diameter of trees, a very great deal depends upon soil, management, and situation; consequently no definite rule as to this point can be stated.

SECTION V.—HOW TO FIND THE VALUE OF GROWING PLANTATIONS, AND OF FULL-GROWN TIMBER TREES.

1296. The valuing of plantations is a point in forestry which, to be done properly and justly, requires the exercise of the judgment of a man who has had long practical experience in the matter. He who gives himself out as a valuator of plantations, in the settlements and divisions of landed property, must be possessed of an accurate knowledge of the prospective value of all the plantations that can possibly come under his notice, under the age of full-grown timber. He must have an intimate knowledge of the habits of growth of the different species of forest trees, and of the influence of soil and local climate on their periodical increase of timber; these qualifications being absolutely necessary in the valuing of young plantations while they are under the age of full-grown timber trees; and as such qualifications are only attainable by a pretty long course of experience as a practical forester, I shall here state only the general method of going to work in valuing plantations.

1297. In taking the present transferable value of plantations, they are divided into three different and distinct classes, namely:—

1st, Plantations not thinned for the first time.

2d, Those which have been thinned, but are under full-timber size.

3d, Those of full-timber size.

As each of these classes is valued in a manner different from the others, I shall here treat of the manner of valuing in each case separately. With regard to the first, then—were I called upon to give the transferable value of any young plantation which had not been thinned for the first time when I saw it, I would in the first place calculate the original expense of fencing, draining, and planting; and having ascertained this point, I would next measure the extent of the plantation in acres, and put upon it a rent per acre, corresponding with the land in the immediate neighbourhood, but in all cases making an allowance for inaccessible heights and hollows. Then the rule for finding the valuation is—to the cost of fencing, draining, and planting, and the rent of the land occupied for the time, add the amount of compound interest on these, at from three to five per cent according to the state of the crop, and the result will be a fair transferable value between two parties.*

1298. With regard to the second class of plantations mentioned above—namely, those which have been thinned, but are under full-timber size:—

When trees attain a size when it is necessary to thin them for the first time, they will then afford certain evidences on which to found calculations of their ultimate produce and value. Therefore, at the time when young trees show evidence of their future health, and until they have attained a full-timber size, the valuation of such plantations ought to proceed on the principle of prospective value, and the rule for doing so is this:—First, determine the number of years the trees will require to arrive at maturity; second, calculate the value of all thinnings that are likely to be taken from the plantation before it arrives at maturity, and that in periodical thinnings of five years from the time that the valuation is taken; and third, estimate the value of all the trees which will arrive at perfection of growth: from the total amount of these sums deduct compound interest for the period the trees require to attain maturity, and the result will be the present transferable value of the plantation.

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* John Lockhart Morton, in his work called *The Recourses of Estates*, at page 239, seems to have laboured under the impression that in giving the above rule for the valuation of young plantations, I take the land on which they grow into consideration as well as the crop. This, however, I do not, as I only refer to the value of the crop, and not to the value of the land at all. I take this opportunity to correct Mr L. Morton's mistake, and to state that the remarks in this section refer to the value of a crop of trees only, and not to that of the land, which is understood to be valued separately, and as if no crop was on it.

1299. With regard to the third class of plantations as above stated—namely, those which have arrived at full-timber size:—

As this is a class of plantations which every forester ought to be able to value at sight, I shall be more particular in pointing out the method of going to work here. Few foresters are ever called upon to value the two first-named classes of plantations, but the case is altogether different with regard to full-grown trees: these are the harvest of their labours, and they are almost every day called upon to cut down and value trees of full-grown dimensions. In this case it is not the transferable value of the unripe crop as found upon the land that we have to do with: it is the simple value of the wood itself—the value of each tree in its perfect state, in so far as the ground is qualified to produce it.

1300. It is often necessary that full-grown timber trees should be valued previous to their being cut down; and particularly in the case of a transfer of property, it is absolutely necessary to have this done, inasmuch as the trees are a part of the property to be sold. In taking the value of timber in its growing state, two methods are in practice among wood-valuators; the one is to measure the height of each tree by means of a measuring pole with a ladder, and by actually girthing the tree in the middle with a cord, and finding the contents in the usual manner of measuring round timber: the other method is, that of judging by the eye the number of feet that each tree may contain.

1301. With regard to the first method—namely, that of measuring the trees by means of a pole with a ladder—some suppose that this is the most correct way of going to work in the valuation of growing timber; and in consequence of this opinion having for some time past prevailed among the older class of valuators, much precious time has been lost by them, as well as useless expense entailed upon the proprietors who have employed them. I have myself seen three men, apparently busily employed for the space of ten days, in the measurement of four hundred trees, by the method in question; and even after all their labour, their valuation was disputed. A friend of mine being called in to make a second valuation, he did so by estimating the size of each tree by sight, and did the whole work in about half a day; and when those trees actually were cut down and measured, his report of the valuation corresponded to within five per cent of the truth, while the report given by the other party was thirty per cent beyond the truth;—this instance at once pointing out the possibility of being very incorrect in the valuation of trees measured with a pole and cord. From the many obstacles that are apt to come in the way, it is almost impossible to measure correctly any large tree in its growing state; and by a short sketch of the manner of proceeding in this kind of work, the obstacles to correctness will at once appear. In measuring trees thus, the valuator has with him two men—the one carrying with him a pretty long ladder, in order to get upon the trees from the ground; while the other bears with him a measuring pole, generally about ten feet in length, divided into feet and inches for measuring the height of the tree, and a tape line marked with feet and inches for taking its girth. With these assistants thus furnished, the valuator proceeds by causing the man with the ladder to hold it to a tree, while the other goes upon it, and with his rod measures the height of the tree as he proceeds upwards. Having ascertained the entire height, as far as may be considered measurable timber, he again measures downwards, one half of the height of the tree, in order to take the girth at that part, for calculating the side of the square; and in this manner the valuator proceeds from one tree to another, noting down the dimensions as he proceeds. Now, as to correctness, this method would do very well, provided that there were no branches upon the trees; and, no doubt, the operators always choose that side of a tree which is most free from branches; but, notwithstanding, there are few trees which, in taking a straight line from top to bottom, have not several branches to intercept the object. This is what makes their measurement so very incorrect; for when the man with the pole has his line of measurement intercepted by one or two branches, he generally has to change his position upon the tree, and this often many times in the ascent of one tree;—often causing, consequently, an error of several feet in the value of one tree, less or more. Mr Monteith, the well-known author of the *Forester's Guide*, invented an instrument, which wrought with a wheel in taking the height of a tree, and this instrument he himself used in the valuation of forest trees. But for the same reason that I have already mentioned—from the wheel being interrupted by the branches of the trees—it soon fell into disrepute, and is now scarcely or ever used; besides, the time and labour required are very much against its being used by active valuators of the present day. Such men, in almost all cases, accustom themselves to estimate any standing tree simply by sight—which is, indeed, when done by an experienced man, the method most to be depended upon. The eye is not easily deceived in the comparative magnitude of any two or more objects; and more particularly, if it has been long accustomed to compare the relative sizes of different objects of the same form, its judgment, if I may so speak, becomes almost indisputable; at least, a man is very seldom deceived by his eyes in the viewing of an object, if he have but accustomed them to act in accordance with his judgment; and this is all that is required in order to give a correct idea of the size of any tree. It merely requires that the eye should be accustomed to the work, and that judgment should never be passed on the size of a tree until the mind is actually satisfied of the truth of the impression produced.

1302. Every forester ought at once to be able to estimate the size of any tree on first sight of it. But a course of training is necessary before being able to do this; and as I myself, in all cases of valuing growing timber, pass judgment of the size simply by sight, I shall here point out the course of training necessary to those who may wish to excel in this most useful point in forestry.

Those who never have accustomed their eyes to compare the relative sizes of different objects, may at first be led to think that it is impossible for any man to give a correct judgment of the exact bulk of one tree as compared with another. This opinion, at first sight, is natural; but the power of habit is well known to be incredible; and those who entertain the idea of there being great difficulty to overcome, may be assured that a few weeks of persevering practice will overcome all the difficulty. When I first commenced training myself to value trees by sight, I was engaged in the thinning of plantations from twenty to forty years old. For a few weeks I, in every case of cutting down a tree, first eyed it from bottom to top, and from top to bottom, and passed my judgment as to the number of cubic feet it contained before I cut it down; and as soon as I had the tree cut down and pruned, I measured the length with my rule, and took the girth in the middle, and, on casting up the contents, I compared the result with my previous judgment of the matter; and at the end of three weeks, which time I was employed in the thinning of the plantations mentioned, I could have told, to within a mere trifle, the actual number of feet and inches in any individual tree before I cut it down. In the same manner I practised myself when cutting down large trees, embracing every opportunity of improving my judgment upon the point, until I came to have perfect confidence as to the correctness of my decision.

1303. But there is one remark which may be useful to mention here, relative to the correctness or incorrectness of the judgment of the eye in taking the size of a tree—namely, the mind must be perfectly at ease. A valuator, with his mind uneasy upon any point foreign from his present purpose, is certain to commit errors; and this I mention, in order that any young beginner who may read this, and may commence his training in the way I did, may be upon his guard at all times when valuing.

1304. Having thus pointed out the way by which any forester may acquire the useful habit of valuing trees by sight, I shall now give a statement of the manner in which I generally go to work in the actual valuation of the trees in a plantation.

When called upon to take the valuation of a plantation of full-grown trees, or, as it may be, a thinning of trees from a plantation, I provide myself with a pretty large passbook, containing, as usual, money columns on the right-hand side of each page, and the spaces upon the left-hand side of the money columns I divide into four equal parts, parallel with them; the first space upon the left-hand side is for entering the numbers to correspond with those intended to be marked upon the trees; the second for entering the species of each tree as it is numbered; the third for entering the number of cubic feet contained in the tree as marked; and the fourth contains the price, per cubic foot, of each tree as numbered. The following sketch of this form of book will more readily assist the learner :—

1305.

Number of each Tree.	Species of each Tree.	Cubic feet in each Tree.	Price per Foot of each Tree.		Value.		
			s.	d.	£	s.	d.
1	Oak,	90	3	6	15	15	0
2	Ditto,	30	2	6	3	15	0
3	Ash,	82	2	0	8	4	0
4	Ditto,	20	1	6	1	10	0
5	Elm,	73	2	0	7	6	0
6	Ditto,	30	1	8	2	10	0
7	Beech,	75	1	6	5	12	6
8	Ditto,	25	0	10	1	0	10
9	Plane,	87	3	0	13	1	0
10	Ditto,	26	1	6	1	19	0
11	Larch,	64	2	0	6	8	0
12	Ditto,	32	1	4	2	2	8
13	Scots Fir,	58	1	6	4	7	0
14	Ditto,	18	1	0	0	18	0

1306. In the act of valuing trees in the forest, I do not, of course, take time to sum up the value of each tree, but leave the money columns blank until I have the work finished, or at least until the evenings when I get home, when I have leisure to do so correctly. Having provided myself with a book of the description mentioned above, all ready and ruled, with the numbers filled in, and the uses of the columns written along the top of each page, I next engage three, or perhaps, if the trees are hard in the bark and difficult to mark, four men of active habit, each provided with an *iron* adapted for the marking of figures upon the bark of trees: one of the men begins by marking No. 1 upon the first tree to be valued, a second man marks No. 2, a third No. 3, and the fourth No. 4; and in this manner the four men follow one another, each of them marking his own number next in succession upon another new tree; that is, if the first man mark No. 1, his next in succession will be No. 5; if the second mark No. 2, his next will be No. 6; and so on with the rest. When the men are properly arranged at their work of marking the trees, I next commence myself with the tree having the mark No. 1 upon it, and write opposite the same number in my book the species of the tree, next the number of cubic feet that I think it contains, and lastly, the price per cubic foot of each tree, such as I think it would really bring in the market at the time of valuation. In the same manner I go on with every tree to be valued.

1307. I may remark here that every valuator of growing timber, previous to entering upon the valuation of it in any locality with which he is not well acquainted, should in all cases make himself properly aware of the general prices of wood in that district; for if he do not, he will unquestionably commit gross errors in his work. If, for instance, a valuator were to be called from Edinburgh to value wood in the county of Peebles, or any other inland district, and he proceeded to value the same according to the rate of wood-sales in the neighbourhood of Edinburgh, his valuation would of course be about one-third too high, because in any inland district there is comparatively little demand for wood: consequently, before the wood could be sold, it would require to be carted by the purchaser a considerable distance to some railway station before it could be taken to a market; and seeing this, the valuator should always regulate his prices according to the prices that he knows will be given at the nearest seaport, deducting the expenses which will be necessary to carry the timber between the place where it is growing and the market where it is to be sold.

CHAPTER XI.

SECTION I.—EFFECTS OF TRANSPLANTING ON THE CONSTITUTION OF TREES.

1308. For many years past, the transplanting of large trees from the forest ground to the park, with the view of producing an immediate effect where these were wanting upon the home grounds of proprietors, has been practised with more or less success, and that in proportion as the operation of removing the trees had been done in the manner least tending to check the healthy flow of vegetable life in the trees so removed.

It appears very evident to me, that any tree, however large it may be, if only in a healthy and growing state, may, under certain circumstances, be as safely removed from one position to another, as the merest sapling from the nursery-bed. If we can, in our everyday practice, calculate on the certainty of a small oak tree growing when it has been removed from the nursery-row to the open forest land, may we not, with equal certainty, calculate upon a large oak tree growing, when merely removed from one part of a landed property to another, provided the operation, in the case of the large tree, be performed with that amount of care and skill which is necessary to preserve in healthy action all its life principles?

1309. I am aware that many entertain opinions, relative to the transplanting of large trees, very different from mine as expressed above; and those who differ from me as to the propriety and practicability of safely transplanting large forest trees, say that the constitution of a young tree is more pliable and not so easily injured as that of a large one, and consequently is not so easily affected by sudden change or removal. This, no doubt, is true; but if we, in the removal of a large tree, can but adjust the operation to the natural wants and requirements of the subject handled in the same proportion as we can do to the smaller one, are we not, according to the usual laws of nature as found to exist in all plants, equally entitled to say that the one will continue in health as well as the other? There can, I think, be no dispute as to that; therefore, in the transplanting of all trees, whether young or old, large or small, all that is required in the operator is, *to adjust that operation to the natural wants and requirements of the subject,* when the success will be as complete in any one case as in another.

1310. Those who maintain that success in the transplanting of large trees cannot be obtained in equal proportion as in the case of young ones, point to the many failures that have taken place in that department of arboriculture, on, undoubtedly, very many landed properties in Britain—saying, at the same time, that a great deal of money has been uselessly expended by proprietors upon that operation, who have had nothing but disappointment as their reward in the end. This I must also admit. But the grand question is, Were those trees which failed to grow according to the expectations of the proprietors who so laudably endeavoured to ornament their estates, and which cost them so much labour to little purpose, transplanted in such a manner as to fulfil the conditions we have specified? I fear not. Wherever this rule has not been attended to in times past, disappointment has been the result; and wherever it shall not be attended to in future, disappointment will also follow as the natural consequence. Having premised the above, I shall now endeavour to point out the cause of disappointment where that has taken place in the transplanting of large trees.

1311. It is not to be wondered at that many of the cases of transplanting large trees, hitherto performed, have failed of that degree of success which was expected as the result, seeing that not one out of ten of them has been conducted upon principles consistent with the ordinary laws which are known to maintain a healthy state of vegetable life. Every tree of any considerable size has its principal feeding roots situated, for the most part, at the greater distance from its stem; consequently, in the case of removing a large tree from its original site, those must necessarily be cut off, and cannot act as absorbents of nourishment for the parent stem afterwards. Keeping this in view, then, is it anything remarkable that we find a tree dying after it has been separated from its means of deriving nourishment from the earth? Such a result is quite in accordance with the laws of nature as found to act upon vegetable life; and this has exactly been the state of things relative to those large trees which, after having been transplanted, either died suddenly or lived a few years in a languid and sickly state, and that just in proportion as they might have had less or more healthy fibrous roots left upon them at the time of removal.

1312. I have not unfrequently seen trees of a considerable size lifted from their original site and transplanted into another, where they were expected to succeed well; and yet they had been, as it were, torn from the soil, and all their roots left in it, little or no precaution having been used to retain them. In such cases, the soil was removed from all the roots to a considerable distance round the stem, leaving only those roots attached which were large and bare, and without any supply of small fibres, those having been separated in the act of removing the earth; and, with as much soil attached to the part where the roots issue from the stem as the nature of the means of conveyance would admit of, the trees were again put into the earth; but in nine instances out of ten the trees so dealt with never again recover so far as to assume a tolerably healthy or respectable appearance.

1313. This has indeed been the most primitive system of transplanting large trees; and as an improvement upon it, a system of previously preparing the roots for removal has been adopted, which, indeed, considering all the circumstances, has been a decided improvement upon the old style, but has not yet been attended with that amount of success which the nature of the case demands, and which it seems quite possible to attain. The system of preparing trees for transplanting, as practised for a number of years past, is this: Any large tree, the transplantation of which was anticipated, had a trench dug round it, at such a distance from the stem of the tree as was considered expedient for the purpose of removal, according to the size of the subject to be handled. This trench was dug so deep into the earth as to cut all the side roots as far down as those were found, with the exception of perhaps two or three, which were left uncut to act as stays in the earth, both for the time being and after the tree was removed. It was then again filled up; but if the soil was naturally bad, a quantity of better was substituted, with the view of the more readily encouraging the cut roots attached to the tree to push out fresh ones to act as feeders when the tree was removed to its new site. In this state it was again left for a period, generally of two years, when all the cut parts of the roots had pushed out afresh into the new soil. The tree was now considered fit for removal, which was performed in the following manner:—

1314. In taking away the earth from its roots, the workmen began first by opening a new trench all round, and exactly upon the outside of the one which had been formerly made, making the level of its bottom a few inches under that of the latter, with the view of the more readily getting under the level of the supply of young roots, now supposed to be made within the compass of the first trench. This being done, the workmen, with small picks made for the purpose, loosened very carefully the body of the soil, as contained in the previously made trench, beginning upon the outside of the circle, and gradually working in among the young roots made, so as to separate them from the soil; and as these progressed, others were employed in throwing out the soil thus loosened, taking care to disturb or injure any of the small tender roots, now hanging loose, as little as possible. In this manner the men followed each other regularly, till they had the ball of earth contained within the compass of the first trench well reduced, and all the young fibrous and other roots, as these appeared, preserved as well as the nature of the work would admit of. When all these had been separated from the soil on the outer part of the ball, the remaining part, immediately round the bottom of the stem, was preserved entire, and taken along with the tree; and as soon as this part had been undermined, or freed of any hold it had perpendicularly in the earth, a pole, which was fixed upon an axle with a pair of wheels, was applied to the stem of the tree, and tied firmly to it, by which means it was pulled down, with the ball and all its appendant roots resting upon the axle and hanging between the wheels. In this state the tree was drawn by horses to the place where it was to be replanted. In the act of replanting, the bottom of the pit, which had been previously made for the reception of the roots, had a quantity of good soil put over it: the tree was then put in, and the roots spread out, and replanted in as careful a manner as possible, new soil being used when that was considered necessary for the health of the plant. In all cases where the situation was an exposed one, and the ball of earth light in proportion to the top weight of the tree, large sticks or ropes had to be used, in order to keep the newly-planted tree firm in its position, until the roots had become properly established in the new soil. And where it was found to shake much from the action of the wind on the heavy top-branches, some were in the habit of putting heavy stones all round on the ball, in order to counterbalance the top weight; others adopted the plan of laying large beams of wood across the ball, sinking their ends into the firm soil on each side, and nailing them to posts driven in at the ends; while various other means were had recourse to, according as the ideas of the parties interested in the work might suggest: all this pointing out that the art of properly and securely transplanting forest trees of a large size was but imperfectly understood; and all this I have myself witnessed in actual practice, performed by men of first-rate standing in the country as practical planters of their time.

1315. Having thus given a very brief outline of the manner in which the transplanting of large forest trees has been conducted by many hitherto, it now remains for us to examine a little as to how far that system of operation fulfils the conditions required, and how far it is commendable or not. First, then, we are aware that no tree can form a healthy development of leaves and branches unless it be supplied with a corresponding healthy development of roots, by which to draw food in the form of solution from the surrounding soil; and yet no healthy tree, although deprived of a portion of its roots, will sustain any permanent injury, provided it be allowed to remain undisturbed in the soil till it has again replaced those roots, if, after new roots have been made, they be preserved from further injury. Secondly, that the merely hard woody portions of the roots of a tree are not of themselves capable of drawing nourishment to any considerable extent from the earth, unless they be well furnished with the small terminal rootlets, which are of a soft, spongy texture, and are considered as the mouths by which the sap is sucked from the earth into the plant; and, thirdly, that those very rootlets, which are so essential to the preserving in a healthy state any tree or plant, are very susceptible of injury, either by being unduly exposed to the action of the atmosphere, or by their fine outer coats or skin coming roughly in contact with any body harder than themselves. Applying those facts, as they are known to affect vegetable life, to the operation of transplanting large trees, as already described, we must conclude thus: The plan of digging a trench round the trees to be transplanted, if not overdone, has no permanent bad effects upon the constitution of a tree; it gives, no doubt, a temporary check to the system of the ascent of the sap, but as soon as the roots have again renewed themselves, the strength of the sap will gradually resume its former tone; therefore, as regards this part of the operation, no important evil can arise; and the first head, as laid down, is thus dismissed. But in applying the second and third heads, the system of transplanting formerly stated is much at fault; for, in removing the soil from the very soft and tender rootlets, which were so recently produced by nature for the support of the tree, their functions are so much damaged and impaired, in consequence of coming in contact not only with the strong atmosphere, but with the hands and implements of the workmen, that they are almost all rendered unfit for any further healthy action. It is in this respect alone that the operation is *not* adjusted to the natural wants and requirements of the subject handled, but is diametrically opposed to sound natural principles; and though the very system of transplanting, which I here consider as insufficient, is yet very frequently practised, I am not aware that its advocates can point out many trees of considerable dimensions, which have been lifted and transplanted by them in this way, without their having received so much injury, that they are yet stunted in their appearance, and do not indicate full health and vigour of constitution as compared with trees not removed. On examining trees transplanted on this system, they may sometimes indeed have a fair outside appearance, like the hectic flush of a delicate person; but, on close examination by an experienced eye, the reality is at once evident: external indications are at once discerned that the inward constitution of the subject is gone, and, consequently, that its duration will be comparatively short. Besides this, the machine which has been in general use for the purpose of removing large trees by the method above detailed is so very imperfect, that no tree of any considerable dimensions can, with any degree of safety, be conveyed by it. When an assistant under-forester, I was employed, along with others, in transplanting pretty extensively upon an estate in Fifeshire, where we lifted from the forest ground a number of pretty large trees, some of them being above fourteen inches diameter near the bottom of the stem, and about forty feet high, and had them planted on the parks where necessary. These trees had been all previously prepared in the manner already detailed. When we took out our trench, and commenced separating the soil from the recently-formed young roots, we found them in the most healthy state possible, and at the same time very plentifully formed on all the old roots which had been cut; and although in most cases we managed to get them relieved in as good a state as the nature of the operation would admit of, yet when we came to have the tree removed from its original stance, we had great difficulty in getting all the roots taken away, without more or less of damage in some way or other. Sometimes a valuable root was unavoidably torn away by coming in contact with the ground, or with the wheels of the janker, as the machine is called; and sometimes another was broken by the men having occasion to handle them when any unforeseen accident occurred; and all this in consequence of the nature of the machine not being adapted to or powerful enough for its work: while I have very often, too, seen a principal limb torn away by coming in contact with the road as the horses pulled the tree along. All this plainly showed me that there was great room for improvement in the process of removing large trees; and from that time I began to consider the operation as practised altogether imperfect, and having a great tendency to hurt the constitution of any large tree so dealt with. As soon, therefore, as I had the management of woods on my own account, I began to experiment and follow a different system, which I shall now detail in the following section.

SECTION II.—METHOD OF PREPARING LARGE TREES FOR TRANSPLANTING.

1316. Having thus had my attention directed to the transplanting of large forest trees for park scenery at an early stage of my practice as a forester, and being convinced that the systems in general practice were not of a nature calculated to insure the healthy establishment of trees so dealt with, I began to think for myself as to how the operation in all its branches might be improved.

As improvements of the first importance in the process, it appeared to me that some successful method should be adopted, whereby every recently made root adhering to the plant at the period when it was to be taken out of its original site should be preserved entire and undisturbed through all the operation of transplanting ; and, second, that a machine of great power should be constructed, by means of which a whole tree, of whatever dimensions, with its ball of earth and roots, should be lifted and conveyed in an upright and natural position, and laid down in its new bed as entire as when taken up. Those two points forming, as it were, the whole art of transplanting, I thought that, could they be attained, any other minor points would be easily managed. In order, therefore, to accomplish them, I set about, in the first place, a system of reasoning in my own mind, and of trying experiments relative thereto. The first question which I put to myself was this : Is it possible to have any given tree in a forest removed, with all its natural roots entire and undisturbed, and placed in the ground again as it was taken up? I did not require to think long for an answer to this question, as it appeared at once very evident that, in order to do this, a quantity of soil would require to be removed, and that all in one piece, which would be quite impracticable, seeing that the roots of one single tree, growing among others, came in contact with those of its neighbours in every direction all around ; and thus I at once saw that, to remove any large tree with all its natural extent of roots entire, and soil attached, must remain an impracticable operation—at least for the present. Secondly, seeing, or at least admitting for the present, that this is impracticable, can no system of raising forest trees be adopted, by means of which, at any given time or period of their existence, they might be removed from their site, with all their roots and soil attached, without those parts being in the least disturbed? The case of a plant in a pot or box suggested itself to my mind, and the inference that I drew from this was, that if we can grow a plant in a pot or box to a pretty large size in a healthy state upon the stage of a greenhouse, with all its roots enclosed, we may as well grow forest trees in boxes of a larger size sunk in the open ground, and, from the circumstance of their roots being all collected there, they might be removed at any convenient time to any required place. This at once appeared quite a practicable case ; and trees in this state could be reared upon any gentleman's property, when they could be transferred in a healthy state from one place to another, with impunity to their roots; provided they were not, in the first place, too long confined within a narrow compass, and that they were removed by a machine powerful enough to do the work safely. This, I say, appeared to me to be a branch of arboriculture quite attainable ; but as no trees had as yet been cultivated upon that principle, such could not be obtained for a considerable number of years ; so that, however practicable this might be in future generations, in the mean time it was out of the question ; for the point wished was, not so much that of rearing trees to a large size for the purpose of being ultimately transplanted, as to have in the mean time any given tree, growing in the usual way in the forest, transplanted safely, with all its roots, &c., to any other part. Notwithstanding that, for the present purpose, the system of rearing forest trees in boxes was thus unavailable, the case of a plant growing in a pot still presented itself to my mind, and no other method I could think of appeared so feasible ; and reasoning from this, it appeared to me, that if a large tree growing in the forest could not be removed with all its roots entire as those were found in the natural state, they might at least be all shortened into a given practicable extent round the tree, without doing the subject any material injury, and this in the way which has been practised hitherto ; but instead of allowing the young roots, issuing from the cut part of the old, &c., to extend themselves unduly, as generally done, let them be confined and collected within a given practicable space ; the tree could then be removed and transplanted, as we usually see gardeners transplant a flower from a pot to the open ground of the garden. This appeared to be the only reasonable and practicable method of preparing trees of a large size for transplanting that I could devise ; consequently, I set to work to have a few experiments made upon it.

1317. Preparative to actual experiments relative to the point referred to above, I began to examine the state of the roots of trees of different kinds, as they were found to exist naturally in different plantations, growing upon various descriptions of soil, and under different systems of management, at all the ages I could conveniently find or come at. As the result of those examinations, I arrived at the following conclusions :—First, a tree of any given species is better supplied with small fibrous roots when growing upon a light porous soil, than on a soil of an opposite character. Second, the roots of trees growing in a heavy or clay soil, extend themselves to a greater distance from the main stem in search of food, than they do in a light and open soil. Third, the small fibrous roots of trees are most plentifully formed near the surface of the ground ; and the deeper in the earth the large roots of trees are found, the fewer fibrous roots are upon them. Fourth, the more confined any tree is among others in a wood, the fewer and the weaker are its roots ; and the more exposed it is to the free influence of the air, the more abundant and healthy these are. Fifth, the more a tree becomes clothed with branches, the better is it supplied with small fibrous roots. Sixth, in soils of a naturally cold and damp character, the roots of trees are few, weakly, and unhealthy; and in those naturally dry, the opposite is the case. Seventh, the principal masses of the fibrous roots of trees are generally found to coincide with the extension of their branches; and they are also generally found most numerous upon that side of a tree which has been most freely exposed to the influence of light and heat.

1318. Having arrived at this stage of my examination as to the natural disposition and character of the roots, and having arrived at the seven foregoing conclusions as signposts for my further guidance, the next step which appeared necessary, in order to arrive at anything like a decided improvement in the art of transplanting large forest trees, was that of putting to practical use the knowledge thus attained. And I may mention here, that, in this preliminary investigation, I spent no less than the leisure time of three years successively. I did not content myself with examining the trees growing upon one property alone; my researches included several estates, and that, too, in several counties both in the middle and northern parts of Scotland; and not till I was thoroughly satisfied as to the truth of the conclusions I had formed, did I begin to set about the experiments now to be described.

1319. In giving a detailed account of the different experiments for determining the mode of procedure best adapted to secure the end in view, I shall begin with the first conclusion in order—namely, a tree of any given species is better supplied with small fibrous roots when growing on a light porous soil, than on a soil of an opposite character. Being, then, aware of this fact, I commenced my experiments with an oak about thirty-five years old, which grew in a light sandy loam on an open situation, and quite free from the interference of any other tree. It was then nearly thirty feet high, with a diameter of stem at bottom of about fifteen inches. The tree was of a fine spreading habit, with branches fully corresponding to its size and age. I first took a cord and tied it loosely about the bottom of the trunk of the tree; and after considering a little as to what distance I ought to cut in the roots all round, I fixed upon four feet as the half of the diameter of the circle I should make for that purpose, exclusive of the diameter of the stem itself. Then with the cord in my hand, held at four feet from the stem as a centre, I described a circle all round, making the diameter of the ball of earth fully nine feet. This being done, I had a trench dug all round on the outside of the inscribed circle about eighteen inches wide, and so deep as completely to go under all the side roots: that depth was in this case nearly two feet and a half, the subsoil being a sort of earthy sand. In digging the trench I found the main roots very plentiful, and pretty regularly dispersed all round, but more abundant on the south and west sides, which were most exposed to the influence of light and heat. As the digging of the trench progressed, I had all the roots carefully and smoothly cut, as those appeared upon the inner side of the trench, so as to leave no roughness on the wounded parts for the lodgment of water about them. Under the depth of two feet from the surface I found the roots scarce, and with few or no fibres; therefore I determined, at this stage of the operations, to have these more closely cut in, so as to cause them to produce a more plentiful supply of small roots for the future health and establishment of the tree when removed. Accordingly I had the ball of earth, situated between the trench and the stem of the tree, undermined all round, leaving it only about twenty inches deep upon the outside, and gradually sloping it downwards as I approached the centre of the ball under the tree, where it might be fully thirty inches deep. This undermining, however, was not carried to such an extent as to come in contact with any of the tap roots situated immediately under the stem of the tree. Had this been done, it would have given too severe a check to the tree, as I considered that the tap roots were essentially necessary for its support, at least until the roots, which were now shortened, had pushed out fresh young ones for drawing in a supply of nourishment. I merely undermined the ball of earth formed about the roots, to the extent of about two feet inwards from the perpendicular of the same all round. Having this part of the work, as detailed, all finished, I next, with a small pick, took away all loose pieces of soil from the sides of the ball all round. In doing this, wherever I found it deficient in roots, I applied the pick, and had the soil taken away till I came in contact with roots; and wherever I found them, I at once left off without disturbing them further. At this stage of my operations, the ball about the roots of the tree presented rather a rough appearance. On some parts the cut points of pretty large roots protruded, and on others the earth was hollowed out, showing that many fibrous roots were lying there; but my meaning for this will be better understood after I have explained how I finished the work.

1320. Before commencing with the work of preparing the ball of earth around the tree as above detailed, I had ready a quantity of half-rotten vegetable mould, consisting principally of leaves and small twigs of woody matter collected from cleanings of the lawn. To this I added an equal quantity of light peat mould, mixing the two well together; and of this compost I put in about nine inches thick all round the ball. In doing this, I began at the bottom or the lowest point of the excavated ground, replacing the soil which was thrown out gradually with the compost; putting it in next the roots of the tree to the thickness already stated, and giving it a slight tramp with the foot in order to compress it a little. The soil which had been removed was then returned behind the compost, and to this also a firm tramping was given, making it pretty solid, and keeping all the worst of the soil thrown out next the compost. In putting in the compost about the roots, wherever I came to a hollow part, as made where there had been few roots upon the ball, I filled them completely up with it, extending it, at the same time, to the ordinary thickness round the outside area of the ball; thus, in places where any of those hollow parts occurred, the compost was sometimes fully two feet in thickness—this being with the intention of encouraging an extra supply of roots to grow at such parts. In this manner I went on with the work till I had the whole extent of the ball equally done; and when I came to the surface level of the ground, I spread about six inches of the compost over on the ball; in which state I considered the preparation of the roots of that tree completed. To another tree of the same kind, upon the same soil, and of the same age and general character, I performed the like operation at the same time; but in this case I had the principal large branches shortened in to the extent of about one-third of their length; that is, I took off about one-third of the length of each of the larger branches, and put them into a regularly balanced state. In this case I did not attempt anything like a regular pruning of the tree by taking off any branches from the stem; I merely shortened in, and that without producing any bad effect as to the natural outline of the tree, any large overgrown limbs which appeared to have an undue ascendancy upon it, and to require an undue proportion of the sap of the tree to support them.

1321. Having thus detailed my first experiment in preparing trees growing upon a light soil for future transplantation, I shall next give a similar statement relative to others growing upon a heavy clay soil, exemplifying the practical bearing of the second conclusion formerly mentioned —namely, the roots of trees growing in a heavy or clay soil extend themselves to a greater distance from the main stem in search of food, than they do when growing in a light and open one. Keeping this fact in view, I sought for two trees growing upon a clay soil, and found such as I desired; the one an ash about thirty-eight years old, and the other an elm of the same age; both good healthy specimens, but both had been a little drawn up in the stem at an early stage of their growth, and, consequently, were what might be termed rather sparsely clad with top branches. However, they were both perfectly healthy and stout in the stem (about the same diameter as the oak), and promised to become good ornamental trees if judiciously exposed, for they were growing in a plantation among others of the same kind. I determined, therefore, upon having their roots prepared; and, with this view, I had two or three trees cut away from about them, in order that they might in future have more free air for the spread of their branches. This being done, I next caused a trench to be opened about the ash, in the same manner and to the same extent as formerly described in the case of the oak. I was absent on other business while the men were employed in casting out the trench of the first tree operated upon, which was the ash. On my return I found that they had thrown out very few small fibrous portions of roots; but what they had come in contact with were principally bare roots, of from one to three inches in diameter; and, following out the lead of a few of those roots upon the outside of the trench, I found that the principal masses of the fibrous roots extended outside to the distance of about other three feet. But having the trench made, I determined to have the operation completed, and judge afterwards of its effects. When the trench was all thrown out, and the ball of earth surrounding the tree undermined as with the oaks, I next took the pick in hand myself, and commenced taking off a rather large quantity of the stiff clay soil forming the ball, in places where there appeared to be no roots existing. In this instance I had to reduce the ball very much; in several parts right through to the bottom of the trench; but wherever I came upon roots of any size, however small, I at once left off there; and in this way I reduced the ball all round till roots of some size or other appeared. This part of the operation being concluded, I next had a quantity of vegetable mould, as before described, and an equal quantity or bulk of well-rotted turf mould, well mixed together, and had all the openings in the ball properly filled up with it, making it rather compact in among the roots by pressing with the hands. When the openings which I had made with the pick were all completely filled up on the flat of the ball, I next commenced and put the compost all round on the outside, keeping it fully nine inches in thickness between the clay soil put in behind, and the nearest of any one of the points of the roots projecting from the ball. This I did in exactly the same manner as in the former case of the oaks; always observing to pack the clay very solidly behind the compost put in, and the compost itself more slightly; and when the whole was levelled to the surface, I covered the top of the ball with the compost to the thickness of about six inches. The elm tree I operated upon in exactly the same manner; with only this difference, that I made the trench round it one foot farther from the tree, by which means I found more fibrous roots within the ball of earth than in the case of the ash. I may also mention that, after I had both trees finished, I had an open drain made from each down to the level of the bottom of the trenches made; for, from the stiff nature of the soil, I anticipated that water might lodge in the trenches and destroy the health of the young roots which might be made.

This I strongly recommend as being absolutely necessary in such work, wherever the soil is heavy; as, by the simple process of making an open drain from the bottom of the trench, no water can remain there, and the tree must altogether be preserved in better health, as well as have the advantage of a more healthy state of soil in which to form new roots.

1322. With regard to the third conclusion arrived at—namely, the small fibrous roots of trees are most plentifully formed near the surface of the ground; and the deeper in the earth the large roots are found, the fewer fibrous roots are upon them—it will at once appear, in referring to the operations of preparing the roots of the different trees, as already detailed, that there were few fibrous roots, comparatively speaking, found under twenty inches from the surface; and to encourage the growth of these under that depth was my object in undermining the ball of earth, and putting a quantity of soil favourable for the production of roots under that part.

1323. We now come to the fourth conclusion—namely, the more confined any tree is among others in a wood, the fewer and the weaker are its roots; and the more exposed it is to the free influence of the surrounding air, the more abundant and healthy these are. Under this head I may remark, that trees of any kind, which have been injudiciously drawn up in a plantation, are the most unfit subjects that can be chosen for transplanting; therefore, in choosing trees for the purpose of transplanting, they should always be taken from the outside of a wood, where they will have had plenty of pure air to develop their branches, and, which is the natural accompaniment of this, a large supply of fibrous roots. It may not be out of place here to give a few hints as to the manner in which I have gone to work on Arniston estate in getting brought into a proper state for transplanting a considerable number of trees, which, when I went to the place, were in rather a drawn-up condition.

1324. On the north lawn at Arniston there were three groups of trees, extending altogether to about four acres, and which, when they were operated on, were from twenty-five to forty years' standing, consisting principally of oak, ash, elm, beech, and lime trees. These groups, when I went to the place to act as forester, were in a very crowded state, in consequence of many firs having been left too long among the hardwood trees which had been intended to form the principal ultimate crop. As I had no convenient selection of subjects for transplanting—without, indeed, going to an inconvenient distance on other parts of the estate for them—and as Mr Dundas wished to transplant large trees pretty extensively at a period not far distant, he gave me permission to have the groups of trees above referred to thinned out to my own mind, with the view of making the trees left there after thinning, form a future nursery for supplying him with subjects for his intended improvements upon the home grounds. With this view I commenced and had all the firs taken out, as also all the hardwood trees which I considered would come to little ultimate value; and, altogether, I think I took out about two-thirds of the whole number of the trees as originally standing before I began to thin. Those left, after having stood about six years, became vastly improved in their health, and made, in general, fine branchy tops, and became clean in the stems, with healthy thick bark; and, by the way, I ought to observe, that any tree which is to be transplanted, of any size, should be possessed of a good, sound, thick, and fleshy bark. If a tree has bark in that condition, it is never easily affected by sudden change of exposure, whereas one with thin bark is easily hurt. In short, those trees made such good specimens, that I had a number of them prepared for being transplanted before I left the place.

1325. Having, I think, now shown how trees in a drawn-up state—which are always comparatively destitute of fibrous roots, and in that state unfit for being transplanted—may be recovered and made fit subjects, provided they are in a healthy state, I may also further remark that, in choosing large trees as subjects for transplanting from any part of a plantation where the trees may have been formerly much confined, it should be carefully seen that the bark of the tree to be removed is in a good healthy state. When, therefore, it is desirable to have any part of a plantation thinned out as a nursery to supply large trees for the purpose, if the trees have formerly stood very close, they should be thinned out gradually, and not to the distance of the desired number of specimens all at once; for in this case, as well as in the case of other thinning of plantations generally, if the work be overdone, disappointment may follow: the trees, if too suddenly exposed, will become unhealthy in their bark; and if so, their future progress will be slow and uncertain.

1326. We now come to say a little relative to the fifth conclusion mentioned—namely, the more that a tree becomes clothed with branches, the better is it supplied with small fibrous roots. In the choosing of large trees for the purpose of transplanting, this is a point which should never be lost sight of; therefore the planter, in looking out for specimens which he would have with good roots, has only to observe the natural state of the tops: if they are spreading and branchy, he may rely upon plenty of good roots; and if they are tall, with few top branches, he may depend upon few roots existing upon them; consequently, such would make the very worst trees to transplant with any hope of success.

1327. I may merely observe, relative to the sixth conclusion—which is, in soils of a naturally cold and damp character, the roots of trees are few, weakly, and unhealthy; and in those of a naturally dry character, the opposite is the case—that in all cold wet soils, the growth of trees is invariably slow, as compared with others upon a dry soil; this arising from the weak and unhealthy state of the roots in the one case, and their more vigorous state in the other. He, therefore, who would wish to remove trees from a naturally cold and wet soil, must first, if he desires to be successful in the operation, have the ground well drained about the specimens to be removed; and either at the time of draining, or after the trees show more vigorous signs of health from its effects, the trees may be prepared in the roots, and afterwards removed with safety.

1328. I now come to relate an experiment which I made upon a tree which I wished to have removed, and which grew upon a soil of cold wet clay. My reason for not relating it before is, that I considered it most proper to come under this head, as illustrating what may be done in improving the health of trees growing upon a cold wet soil.

On the estate of Craigston, in Aberdeenshire, where I prepared the oaks, the ash, and the elm, formerly referred to in this section, there grew a very fine-shaped Scotch elm, upon a flat piece of ground, which was of a stiff clay nature, and was, besides, naturally wet, and the subsoil of a cold clay till. The tree might be about fifty years old, and was, in consequence of the cold nature of the subsoil, showing symptoms of prematurity, which was indicated by the annual growths of young wood becoming small and weakly, and the leaves falling off very early in the autumn. As this tree was of a very spreading, fine, ornamental habit, I determined to attempt having it, if possible, put into a better state of health, and if I succeeded, to have it afterwards transplanted to a better and more interesting situation. With this view I had a trench, fully three feet deep, cast about it, at a distance of about six feet from the stem all round. This trench I dug about two feet broad; and in the act of making it the water stood plentifully when two feet under the surface, at which stage we were obliged to make a drain from it to a water-run close by. The drain being made, we got the water in the trench let off, and proceeded with the same to the desired depth. In the act of cutting the roots as we made the trench, we found them in a very bad state indeed: many of the larger roots had become entirely rotten, and upon the healthier parts the fibres were delicate and small. This was especially the case with the roots as found lower than about sixteen inches from the surface; above that depth the roots were in general in a healthier state, and seemed not to have suffered so much from wetness; but over the whole extent of the ball they were weakly and unhealthy as compared with trees growing upon a drier soil. Having the trench finished, and the ball undermined as in former cases, the most earthy part of it well reduced, and all bad roots cut clean away, I had a drain made with stones all round the bottom of the trench, and conducted out to the burn. This being done, the ball was prepared and made up with compost, in the same manner as already detailed with regard to the ash and elm.

1329. Before making any remarks as to the effects produced upon this tree by the operation performed upon it, I shall say something relative to the seventh conclusion—namely, the principal masses of the fibrous roots of trees are generally found to coincide with the extension of their branches; and they are generally found most numerous upon that side of a tree which has been most freely exposed to the influence of light and heat.

In reading the above conclusion as laid down, it must not be understood to signify that masses of fibrous roots, growing from any tree, never extend beyond the spread of its branches. On the contrary, the principal masses of the fibrous roots of a tree may sometimes be found to extend very much beyond this; but in such a case there must exist an extraordinary cause—that is, in all cases where a tree is found growing in a soil of equal fertility throughout, the principal masses of fibrous roots will be found generally to coincide with the extension of its branches; while, on the other hand, if any extraordinary nourishing property exist not far distant from the roots of a tree, such as a water-course, a stratum of soil of a superior nature to that in which the tree may be standing, or heaps of manure, &c., they will far outgrow their usual pace in order to reach such extraordinary nourishment; and when they have, as it were, attained their desired possession, the principal masses of fibres will grow out and congregate there, although at a considerable distance beyond the extension of the branches. This may often be observed in the case of trees growing on the side of a wood where a well-cultivated piece of land may happen to be; then the roots will be found in tufted profusion in the land, and at a great distance from the trees themselves; and the same thing may be observed in the case of the roots getting into drains. All these cases, however, are extraordinary, and are not to be taken into account in speaking of the nature of trees as found under ordinary natural circumstances.

Admitting, then, as a truth founded on practical observation, that under existing circumstances the principal masses of fibrous roots of trees are generally found to coincide with the extension of their branches, an important question naturally arises—Should we not, in the removal of a large tree, carry along with it a ball of earth equal to the ordinary spread of its roots in the earth; or, if not to the extent of the spread of the roots in the earth or the branches in the air, by what rule are we to be guided in the operation?

Relative to this, as well as to many other matters of forest operations, different opinions are held. Some maintain that, in the act of transplanting a large tree, all its roots should be bared and traced out to their full extent *as nearly as possible*, and removed entire along with the tree, without any respect being paid to a ball of earth; while others hold that no previous preparation is necessary for the removal of any tree, but that lifting a ball of earth, varying from eight to twelve feet in diameter, according to the size of the tree, is quite sufficient for its safety, without any attention to the natural spread of the roots in the earth. Such opinions are so contradictory in themselves, and so void of sound natural principles, that we shall at once dismiss them as unworthy of attention. We live in an age in which mere assertion has little weight; therefore, in answering the question as above laid down, we must attend to the effects of experience, as that is based upon sound natural principles relative to the laws of vegetable life.

1330. I have already said, in the section immediately preceding this, that no tree can form a healthy development of leaves and branches unless it be supplied with a corresponding healthy development of roots by which to draw food, in the form of solution, from the surrounding soil; and yet no healthy tree, although deprived of a portion of its roots, will sustain any permanent injury, provided it is allowed to remain undisturbed in the soil till it has replaced those roots.

Now, admitting the above assertion to be true, as I have found it to be in my own experience, the reader will at once see that, to deprive a tree of its roots, and to remove it to another soil at the same time, is the very means to prevent its making healthy progress in future; and, at the same time, he will readily see that although any tree should lose a portion of its roots, if it be allowed time to replace them without being further disturbed till it has done so, no permanent injury will follow. Keeping in view, then, that a tree cannot make a healthy development of leaves and branches unless it be supplied with a corresponding healthy development of roots, and that it will not sustain any permanent injury though it lose a portion of its roots, if it be allowed to remain undisturbed till it replace them, I have laid down as a rule for my own guidance in the transplanting of large trees, to have their roots previously prepared by cutting them in by means of a trench dug all round, at a distance from the tree equal to *two-thirds of the diameter of the spread of the branches*—that is to say, if the diameter of the spread of the branches be twelve feet (not including the extreme points of large branches), the diameter of the ball of earth inside the trench should be eight feet, and so on in proportion.

1331. To the inquiring reader another question will naturally arise here—namely, What object is gained by the cutting of the roots by means of a trench; and why define two-thirds of the diameter of the spread of the branches in preference to any other distance? My answer, which is entirely based upon the result of my own experience, is this: With regard to the object gained by the cutting in of the roots previous to the removal, let any one who may have two rows of oaks or any other kind of hardwood trees in the nursery of a pretty large size, say five or six feet high, have all the side roots of the one row cut in with the spade upon each side, say about six inches from the trees in the line, but not so deep as to cut any of the *tap roots*, which are meant to supply the tree with food till new ones are made upon the sides, and leave the other row uncut in their usual natural state. In twelve months after the trees in the one row have been cut in, have them lifted, and the side roots will be found very plentiful in small fibres, and in an excellent state for being safely removed to the forest ground; whereas, on lifting the row of the same age, the trees of which were left uncut, the side roots will be found extremely spare, and the fibres for the most part left in the ground; and on planting the trees as contained in the two rows out into the forest, under equal circumstances of soil, situation, and management, the observing forester will very soon have occasion to decide, without the least hesitation, that those which had their side roots cut in, twelve months previous to their being removed, are far more healthy, and making more rapid progress than those which were not cut till the time of their removal. It is exactly on this same natural principle that I advise to have the side roots of all large trees cut in previous to their being lifted; and I may further state, regarding this point, that I have so often practised this method of cutting in the side roots of pretty large trees in nursery-rows previous to having them transplanted to the forest ground, and have found the effects of the operation so beneficial, that my mind is now quite decided as to the improvement that takes place in trees so managed, compared with others which may be lifted and planted out in the usual manner. The object, therefore, gained by cutting in the side roots of a tree previous to having it transplanted is, a great supply of young fibres, all in readiness to draw in nourishment as soon as it is put into its new site, which is never the case when a tree is removed without any previous preparation.

1332. My reason for defining two-thirds of the diameter of the natural spread of the branches in preference to any other distance is, that at that distance from the stem of a tree, all the large and hard or matured portion of the root is enclosed within the circumference of the ball, while on the circumference of the ball itself, at that distance from the stem, the roots are found pretty regularly ramified, and of a character and consistency of wood the most likely to send out numerous healthy fibres for the future support of the tree.

1333. Having now, I think, pretty fully explained the basis upon which I have formed the plan of preparing large trees for transplanting, I shall, before summing up the general statement of that plan, say something as to the result of my operations on the oaks, elms, and ash trees, as already detailed in this section.

These operations were all performed upon the trees just when I went to the place in the month of November; and my intention then was to have the trees removed to other situations. But as I had occasion to leave the place (Craigston) exactly two years after the trees had been prepared by me, and finding that it was not convenient to have them transplanted before I left the place, I determined to have them examined as to the effect produced on the roots by the cutting in they had received, which would have a tendency so far to confirm my experience in future operations of the like nature. With this view I had openings made at four parts, at equal distances, upon the outside of each of the trenches formerly made round the trees, taking care to make the openings immediately on the outside of the good soil as formerly put in, and in such a manner as not to disturb the young roots made in it; and upon examination I found, to my great satisfaction, exactly as I had previously anticipated—that the whole of the body of new soil which was put round the roots upon the ball of earth, was actually filled with the masses of young fibrous roots that had grown from the old ones which had been cut; and these had not, at this period, begun to grow out into the natural soil beyond; but the mass of new soil which had been put in, with its roots pervading it, very much resembled the roots and ball of a plant which had been long confined in a pot, as may be often witnessed by gardeners in the act of shifting plants from one pot to another. In this state I considered the trees could be removed with all safety, provided that the whole ball of earth, with its young roots enclosed, could be removed without being materially disturbed. I may remark here also, that in my examination of the roots of those trees, I found those upon the light soil most plentifully supplied; upon the heavy soil the roots were indeed good, but not so plentiful, nor so much ramified through the good soil, as in the case of the others; and this, of course, would be occasioned by the original quantity of the roots in the tree growing in the light soil being greater than that of those in the heavy soil. The former, therefore, which were the oaks, I would then have transplanted at once; but the latter, which were the ash and elms, I would have allowed to remain for a year longer, with the view of giving them a longer time to form a greater supply of roots before having them transplanted—a point which requires to be kept in view by the planter.

1334. I said that I pruned one of those trees of part of the heavy branches at the time that I had them prepared in their roots: this pruning had a very beneficial effect on its after health. In all cases of cutting in the roots of trees in the manner above described, it is observable that they receive a slight check in their growth; but in the case of the tree which I had pruned in a slight degree, there was not nearly so much apparent check as in that of the one which received no pruning. This at once gives evidence that, when trees are prepared in their roots with a view to transplanting, they should have a judicious course of pruning, which tends to secure, as it were, a balance between roots and branches; that is to say, when the side roots are checked and made incapable of supplying nourishment for a time, the health of the tree is much improved under the operation by having a proportion of the top branches shortened in also; for by this the roots are relieved of a burden they would otherwise have had to support; this tending, as I have already said, to throw a better balance between roots and branches, and consequently to retain the tree in better health under the operation.

1335. Having been disappointed in getting my transplanting operations put into execution upon the estate of Craigston, although I did not, at the same time, find myself disappointed as to the results attendant on the plan I had adopted in preparing trees for that purpose there, and having had no convenient opportunity of extending my experience further upon that point of arboriculture till I went to Arniston, as soon as I went there I had some trees prepared in the same manner for transplanting as I had already done at Craigston.

1336. While at Arniston, I had my attention too much engaged with other general forest improvements to allow me to have much time devoted to the transplanting of large trees upon the home grounds; but Mr Dundas wishing to have a few large trees put upon an open part of the east lawn, requested me to have that done at a convenient time. Accordingly, I fixed upon a few lime trees, about twenty feet high, for the purpose, and had them prepared in their roots exactly as I have already detailed in the case of the trees at Craigston; but as the trees in this case were much smaller than those I operated upon in the last-mentioned place, on the principle already laid down, I had the roots cut in by a trench at three feet distance from the stem all round, making the ball of earth, including the stem, nearly seven feet diameter. Having remained in their preparative state for two years, I was about to have them transplanted, when, in the course of other improvements of an agricultural nature upon the lawn where they were to have been planted, it was considered proper to defer putting trees there till these improvements were finished. As, however, a continuation of a line of trees was necessary upon the side of one of the approaches, Mr Dundas wished them put in there, which I did by means of the pair of wheels with a pole, termed a janker, not having any other machine for the purpose.

When I lifted these trees from their original site, I kept all the young fibrous roots formed upon the circumference of the ball as whole and undisturbed as possible; not even removing any particle of earth from among the young roots, except what could not be avoided, in consequence of the nature of the machine being imperfect, and not adapted for raising out of the ground any heavy body of earth. Even with this machine, imperfect as it was, I managed, by great care, and the assistance of a few active stout men, to have the balls attached to the trees pretty safely removed, and with the young roots comparatively uninjured.

As the trees which I had previously prepared for transplanting, were only about a fourth of the number required for finishing the continuation of this line, and as Mr Dundas wished the line finished in order to have the full effect desired, I determined upon having that part done with trees which had got no previous preparation of their roots. This was done in as careful a manner as possible, removing all the earth with the roots as far as the nature of the machine was capable of doing; but, notwithstanding, these last were, at the time I left the place, decidedly inferior to their neighbours which had their roots previously prepared. Three years after these trees were removed, the few which were previously prepared in the roots had not shown the least symptoms of anything like a check, whereas the others which received no previous preparation received a great check; their appearance, even when I left the place, indicated a want of vigour. This at once points out that, in order to remove large trees safely, and with the hope of future success, they must first be prepared in their roots; or if not, the subjects acted upon will receive so violent a check, that they will never after resume that healthy character which is so desirable in park trees.

1337. Having now said so much regarding the nature of removing large trees, I shall conclude the present section by laying down a kind of abstract of the manner of proceeding with the preparing of large trees for transplanting, which, let it be understood, is the system I have laid down for my own guidance, and is entirely based upon the results of my own experience.

1338. *First,* In choosing a tree of a large size for removing to another place, I first see if it be well clothed with branches; for if the branches be few, the roots will be correspondingly few.

Second, If one or more of the branches forming the top, appear to bear an undue proportion to the main stem, I have such shortened in by at least one-third of their whole length, but never in such a way, or to such an extent, as to give the tree a formal or artificial outline. This I do with the view of reducing, as far as consistent with good management, the demand for food upon the roots after they have been cut in.

Third, Taking the perpendicular *drip* of the general mass of the points of the branches, as the circumference of a circle round the stem of the tree, after the strong limbs have been shortened in, I next take two-thirds of that as the diameter of the ball of earth to be left inside the trench to be formed.

Fourth, The circle being inscribed round the stem of the tree, I next take out a trench, on the outside of that circle, from eighteen to thirty-six inches broad, according to the size of the tree, keeping the earth to the outside, and have all roots as they appear upon the inside of the trench smoothly and carefully cut, and that to such a depth as the roots of the tree may be found, which is generally from two to three feet under the surface.

Fifth, The trench being made, I next pare off with the spade all loose soil from the surface of the ball of earth now formed on the roots of the tree; and, at the same time, with a pick take away all earthy parts of the ball in which no roots exist, with the intention of putting in soil of a nature congenial to the growth of roots; and in order to encourage the more readily that growth on the under part of the ball, I have it undermined to the extent of two to three feet within the perpendicular, and the earth thrown out to be replaced by better soil.

Sixth, All the parts of the work as above stated being finished, I next bring forward, which is understood to have been previously prepared, a quantity of any light vegetable mould, such as has been already described, and have it put about the roots of the tree to the extent and in the manner already detailed.

Seventh, If the trees be originally growing on a soil of a light nature, which is naturally congenial to the production of numerous roots, they may be safely removed in two years after the roots have been cut in; but if upon a soil of a heavy or clayey nature, which is not so congenial to the growth of these small roots, the trees so situated will be the better of remaining three years in their preparative state; for as the original quantity of roots was comparatively small, the more time will be required to make good that deficiency in the good soil put in for that purpose.

1339. Some will probably consider the system of preparing large trees for transplanting, as herein laid down, an expensive operation; but those who may, at the first glance, and without due consideration, think so, may be assured that it is the cheapest and most satisfactory plan in the end. There is no doubt that trees may be removed at a cheap rate from one place to another without any such preparation as has been advised; but the grand question is, Can they be otherwise more cheaply removed with an equal hope of success as to the object in view? I am not aware that they can; and this has been shown from the case of others, as well as from the results of my own experience; for it is most reasonable to suppose, even by those who may have had no practical experience of their own, that a tree removed from its original site, having numerous small fibres formed at all the extremities of its roots, must have a much greater assurance of future health than one removed without any of these. No proprietor of judgment and taste would hesitate one moment as to the outlay of a few extra pounds upon such a work as the transplanting of large trees, when he is aware that by the system of preparing their roots he is likely to have the greatest amount of ultimate satisfaction.

1340. The expense of preparing a tree of thirty feet high, for transplanting in the manner advised, may stand thus:—

	s.	*d.*
Two men one day throwing out soil from the trench, at 2s., .	4	0
Cartage of three loads of light soil, which need not be valued, being the proprietor's own, ...	2	0
Two men one day putting in soil, &c., at 2s., ...	4	0
	10	0

The above valuation of the work is amply sufficient; and where men are accustomed to it for a time, it may be done for a much smaller sum; but even allowing that each tree, of thirty feet in height, to be transplanted, should cost 10s. in order to secure its future health, it is infinitely better spent upon that operation than if no preparation had taken place; and as the work of transplanting large trees must in all cases be an expensive one, it is but right that it should be done in a proper manner.

The next thing to be considered is the work of removing large trees after they have been thus prepared: and this will constitute the subject of the following section.

SECTION III.—METHOD OF TRANSPLANTING LARGE TREES, AND DESCRIPTION OF MACHINES FOR PERFORMING THAT OPERATION.

1341. At the beginning of the preceding section, I remarked that, as improvements of the first importance in the removal of large trees, it appeared to me that some successful method should be adopted whereby every recently made root adhering to the plant at the period when it was to be taken out of its original site, should be preserved entire and undisturbed through all the operation of transplanting; and second, that a machine of great power should be constructed, by means of which a whole tree, of whatever dimensions, with its ball of earth and roots, should be lifted and conveyed in an upright and natural position, and laid down in its new bed as entire as when taken up. Now, keeping this in view, and having already pointed out the kind of preparation that appears to me necessary for the safe removal of all large trees—without which preparation every recently made root adhering to the plant when it has to be taken out of the ground for transplantation cannot be preserved entire and undisturbed through all the operation—I next come to point out how trees thus prepared may be safely removed by means of a powerful machine recently invented.

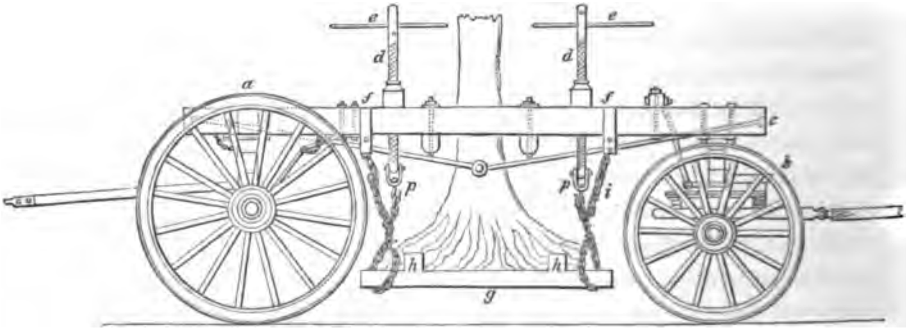
1342. For some years I had been attempting to make a model of a machine powerful enough for the safe removal of large trees, upon the principle above stated—that of removing them with all their roots entire and undisturbed as they were found after the preparation had been effected. But not being able to produce from my own hands anything at the same time simple and effective enough for the purpose, I had just given up the attempt, when I happily read, in the *Gardeners' and Farmers' Journal* of the 15th December 1849, the following, being part of an article by the editor:—

"There are few things more desirable, and perhaps none which it is usually found more difficult to accomplish, than that of building a mansion on a bare knoll, and in the space of four or five years giving to it the character and effect which, by the ordinary process of nature in the growth of timber, requires a period of thirty years or more. Desirable as this undoubtedly is—difficult, impracticable, and wonderful as it may seem, it can be done.

"Our readers are aware that within the last few weeks we have passed through some of the northern counties, and visited such gardens on our way as appeared to claim our attention. As one of those, we called at Kingston Hall, the seat of Edward Strutt, Esq., Kegworth near Derby. Here, then, we were delighted to find the all but impossible thing to which we have referred above, realised to an extent very much exceeding what we had anticipated. In the early part of 1843 Mr Strutt commenced the erection of Kingston Hall, selecting for its site the slightly elevated ground in the midst of the estate, where no house or tree existed before. In due time the mansion was reared, forming a structure, in the Elizabethan style, of very considerable extent, designed by the well-known and eminent architect, Mr Blower. Nothing was done in the way of planting until the house began to show its bulk and general outline; and at this juncture, doubtless, not a few persons would gravely suspect that Mr Strutt had committed a serious mistake in building a magnificent residence where he could not reasonably expect to see trees much taller than himself during his own lifetime. How far Mr Strutt, or those about him, foresaw the means of meeting this objection, we are not prepared to say; but in October 1844, a pair of large wheels was provided, in accordance with the well-known plan of Sir Henry Steuart, recommended by him in his celebrated work on the improvement of estates and the transplanting of large trees. By means of this machine, about twenty trees of various sizes, from fifty feet downwards, were brought from St Helen's, one of Mr Strutt's estates, near Derby, and that upon which he then resided, and planted at Kingston. It was found, in the course of drawing these trees so great a distance (thirteen miles) along the public highway, with many of the branches frequently trailing upon the ground, that the latter got seriously injured and broken; nor did the trees themselves, when replanted, succeed sufficiently to warrant any very extended operation upon this plan. A new machine was therefore constructed, upon a principle somewhat similar to one invented by Mr Barron, who has conducted the works at Elveston with so much success. This new machine, which was built by Mr Mackay, Mr Strutt's gardener, for the future operations of tree-lifting at Kingston, is that represented in the accompanying engravings, and has been employed at Kingston Hall, where, in the short period of four or five years, a bare knoll has been transformed into a grove."

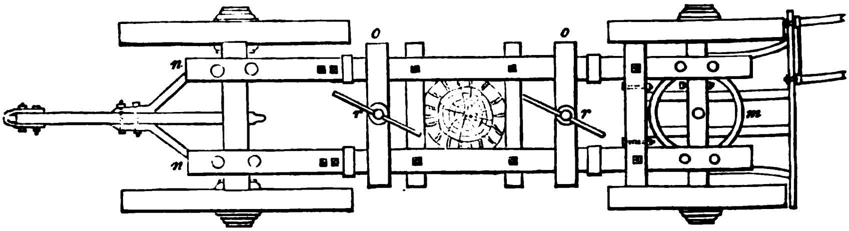
1343. Upon reading the article in the journal relative to the nature of the machine used for transplanting trees at Kingston Hall, part of which I have quoted above, my attention was at once called to its great value to other proprietors who might have work of the same kind to perform in future; and I took the first convenient opportunity of going to Kingston Hall to examine for myself as to how far the machine referred to was likely to answer the end in view—namely, that of its being in all respects adapted for safely lifting trees of any size in the work of transplanting. With this view, therefore, I went to Kingston Hall, and saw Mr Mackay, the very intelligent gardener there, under whose able directions all the work of transplanting with the machine had been performed. He very kindly

Fig. 140.



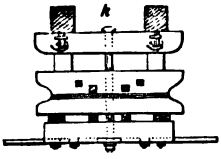
SIDE ELEVATION.

Fig. 141.



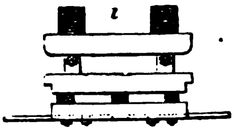
GROUND-PLAN.

Fig. 142.



END SECTION.

Fig. 143.



END SECTION.

caused his men to have the machine brought out and put into working order in my presence; and, on a thorough examination of its structure and working capabilities, I am led to say, from my own observations, that it is exactly such a machine as I have long wished to see constructed; and I must also state, that it is in every respect adapted for the purpose of lifting and transplanting large trees in the most safe and efficient manner.

1344. Mr Mackay has two machines which he has used in the transplanting of his large trees at Kingston Hall, both of the same construction, but different in power; the one used for transplanting trees of twenty-five feet in height and under, and which may be capable of safely removing a weight of about five tons; the other he has used for transplanting trees from thirty to forty feet in height, which is capable of safely removing a weight of from ten to fifteen tons—that is, including the tree and its ball of earth attached. Trees of the latter weight Mr Mackay told me he had removed; and having examined these, I estimated that some of them would weigh about fifteen tons, including the ball of earth.

1345. Before entering into detail as to the manner of working the machine, I shall first give a statement as to the nature of its construction.

It consists of two pairs of wheels, each pair working upon a strong axle of superior quality. In the largest machine as referred to above, each pair of wheels is about nine inches broad in the rings. The pair situated on the front part (see engraving at *b*) are about five and a half feet in diameter, and the pair situated on the hinder part (see engraving at *a*) are about seven feet in diameter, and distant from each other about fifteen feet; thus making the length of the machine, from the one axle to the other, fifteen feet. On each of the axles is placed a strong frame, in order to raise the horizontal bearers to a convenient height, and at the same time with the view of making the whole machine move in a workable manner. (See section of front frame *k*, and section of back frame *l*.) The front frame, I may also state, is made to turn upon a horizontal wheel, in the same manner as in the case of a carriage, for the easy turning about of the machine in any required direction, as is represented in the ground-plan of the tree-lifter at *m*. Resting upon the frames, as is shown in the front and back sections, and parallel to each other at a distance of about two feet apart, are two strong beams of wood, about ten inches deep by six broad. (See side elevation of the tree-lifter at *c*, and also on the ground-plan at *n n*.) Those beams are fastened to the frames placed above the fore and aft axles, by means of strong iron bolts, which can be unscrewed as occasion may require; and, placed across upon those horizontal beams, again, are two others (see ground-plan at *o o*), into which the jack-screws are placed. The screws are also shown in their working state in side elevation *d d*, with their cross-handles for turning, *e e*. On the under part of those jack-screws, as passed through the cross beams, are attached the strong chains by means of which the tree is principally taken out of its place (see *p p*); and, as an assistant to them, there are side chains attached to strong iron rings fixed upon the beams (see *ff*). Those side chains are made to act along with the others attached to the screws, and are also found necessary to retain the weight of the tree and its ball of earth during the reversing of the screws for a new hold. The horizontal planks upon which the ball of earth rests, supported by the chains, are shown on side elevation at *g*; and the two cross planks, which are placed upon the horizontal ones for the better support of the ball, are also shown at *h h*. Those planks require to be made of the best oak wood, not less than four inches thick.

1346. Having now given a brief description of the construction of the machine as I examined it upon the spot, it remains to be stated how the operation of transplanting a large tree is accomplished by it.

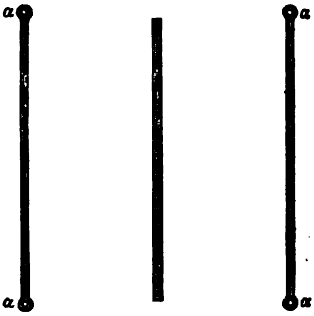
The work of transplanting a tree with the machine above referred to, is perfectly simple and easily understood; and in describing it I could not do better than lay before my readers the manner of proceeding as detailed by Mr Marnock, who was editor of the Journal formerly referred to, who visited Kingston Hall, and saw the work performed. In the Journal of the 22d December 1849, he writes thus:—"In our last week's number we stated that we had seen some elm-trees at Kingston Hall, the seat of Edward Strutt, Esq., carried by the machine then represented, and replanted in another situation about three-quarters of a mile from the place where they had stood and grown for upwards of thirty years. We further stated that these trees were forty feet in height, and weighed each, including the ball of earth and the machine, upwards of ten tons, and that they were drawn by nine horses. We shall now, therefore, give the following details as to how this was accomplished. The trees to which we now allude were growing on the outskirt of a wood. The ground around the tree was cleared, and at four and a half feet from the stem of the tree a circular cutting was made to the depth of about three and a half or four feet, and about two and a half feet in width. This done, then on the most open side of the tree a sloped cutting was made, from the surface of the ground to the bottom of what may now be called the ball of earth, and a similar sloped opening was made on the opposite side of the tree. The first of these sloped cuttings was made for the purpose of drawing out the tree up this slight incline to the surface of the surrounding ground. The circular opening in the earth around the tree, and the two sloping roads on each side, being now prepared, the workmen commenced to undermine the ball of earth; this being done all around, four stout oak planks, long enough, were placed under this ball of earth in front and behind—that is, crossways to the direction of the machine; and under these two others were placed lengthways, with their ends in the direction to back and front of the machine. It will now be understood that these four oak planks under the ball of earth cross each other at their four extremities; and around their extremities, at each of the four corners, four sets of strong iron chains are fastened. A reference to the diagrams given will assist in explaining this. The first set of chains brought into play were those attached to the bottom of the jack screws. Being made as tight as possible over the ball of earth, they were then hooked on the end of the jack. The two jacks were then turned by two or four men each, as the case may require, until the tree and the ball of earth were raised from the ground about six or ten inches. The jacks were then permitted to rest, and what is called the side chains were then put in requisition. These, as we have already stated, are fastened to the planks under the ball of earth, at the same point as the others, the opposite ends being made fast to the side beams, as shown in the engraving. This being done at the four corners, the jacks are then reversed, and the first set of chains slackened: the weight of the earth and tree is then sustained by the side chains. The first set of chains are again adjusted, and made as tight over the ball of earth as manual power can effect. The jack is again run down, and again attached to the chain at the lowest point it will reach. The jacks are once more applied, and run up till the end of the screw has been completely worked up to the under-side of the cross beam on which it rests. By this second lift the jacks have probably gained upon the six or ten inches which they made at the first lifting, and the bottom of the ball is now fifteen or twenty inches from the ground. The side chains, which are now quite slackened by the second lift of the jacks, are again made as tight as possible; this accomplished, and all securely and equally fastened to the side beams again, the jacks are gently reversed, till the weight is equally divided betwixt the side chains and the jack chains. The tree is now in a condition to be drawn out, unless it should be necessary to give it a third lift with the jacks, so as to raise it still higher from the ground; and if so, the side chains must always be attended to, as already described. They may be properly called the guard-chains, as they prevent accidents in the event of breakage of any of the jack chains, when the former would take the weight of the tree, and prevent its falling. About ten or fifteen feet up the stem of the tree, four ropes extend from this point to the two front and two back corners of the machine; and this is all that experience has found necessary to preserve the tree in its perpendicular position during its transport on the machine to its future place of growth. The perpendicular position of the tree is, however, very greatly secured by the four side or guard chains. We have now to describe the mode of introducing the stem of the tree within the machine. This is effected in the following manner: The machine is drawn as near to the tree as circumstances will allow; it is then taken to pieces by unscrewing the different bolts—that is, the main horizontal beams are unfastened, and thrown over the wheels on either side. The larger hind wheels are then placed in their proper position on the sloped cutting behind the tree, and the smaller fore-wheels on the sloped cutting before the tree; the large beams are then lifted on to their places, one on either side of the tree, and made secure with the iron bolts and the requisite fastenings. The tree then stands with its stem betwixt the side beams, and with a pair of wheels behind and another before. The chains and jacks are then applied as already described, and thus the process is complete. The next and only point deserving further allusion, is that of planting or placing the tree where it is ultimately to grow; and this is effected in the following way: The hole, sufficiently large to receive the ball of earth, is dug the necessary depth; then, on the opposite sides of the hole, a sloped cutting, wide enough to admit the machine to be drawn down and through it, is also provided. Into this cutting, therefore, the machine and tree are drawn, and through which the team of horses first pass. When the tree has reached the proper point, the machine is permitted to rest; props of brick or stones are then raised at the four corners immediately under the ends of the cross planks. These props may be three or five bricks in height; and when all is prepared in this way, the jacks are reversed, and the ball of earth gradually lowered down, till the ends of the cross planks rest upon the corner props, and the tree has taken its proper perpendicular position; and this is effected by the raising or lowering of these corner props. All being adjusted, any opening that may remain, betwixt the bottom of the ball of earth and the bottom of the hole provided for the tree, is filled up with earth; the whole being made firm around and under the roots of the tree. The brick or stone props are then struck out, and the planks removed—a process easily effected, as the tree now rests upon the earth which has been placed under and about it. These planks are, however, well ironed at each end, that, in case of any difficulty in their removal, a horse or horses may be readily yoked, and the planks withdrawn."

1347. Having now, I think, fully explained the nature and working capabilities of the machine, which I recommend for the safe transplanting of large trees, I may further state, that the larger machine, which is capable of removing a tree with its ball of earth, of a weight varying from ten to fifteen tons, cost about £60, and the smaller one, which is capable of removing a weight of about five tons, cost about £25; and it is evident that, by increasing the strength and power of the machine, it may be made to remove a tree of any given weight and dimensions. We are thus now in possession of a machine vastly superior to any other thing of the kind that has ever been introduced to the notice of landed proprietors for the speedy ornamenting of their home grounds; and where proprietors will take the trouble to prepare their trees in the roots, in the manner which I have recommended in the section immediately preceding this, and allow them to remain for two or three years, till the ball of earth has become one mass of fibrous root, the whole may be then lifted, by means of this machine, in one entire piece, without disturbing almost a fibre; and any tree removed in such a favourable state will never show any symptoms of want of vigorous growth, which has not been the case with most large trees hitherto planted on principles which left the young roots exposed and injured in the act of removal.

1348. The foregoing remarks are chiefly applicable to the removal of large trees, weighing, with their balls, from four to fifteen tons. In transplanting small trees and large shrubs, however, and such as with their balls may weigh from one to three tons, we do not ourselves use the large and powerful machines just described, but a more simple one, in the form of a flat sledge made of thick and strong sheet-iron, supported with bars of the same material. Some three or four years ago, I read an article in the *Gardener's Chronicle*, recommending, as a simple and efficient means of removing small trees and large shrubs, to use a square sheet of iron, with a hole in each of the corners, in which to attach the horse-tackle in hauling it along with the plant and its ball of earth. I took the hint from this suggestion, and had a sledge made on a similar principle, for our own use in removing some trees of twenty feet high, from one part to another on the lawn at Castle Grant; and as I have found it very suitable for the safe removal of trees and shrubs not weighing more than two powerful horses can drag, I shall give the specification of the one we had made, and which we are in the habit of using.

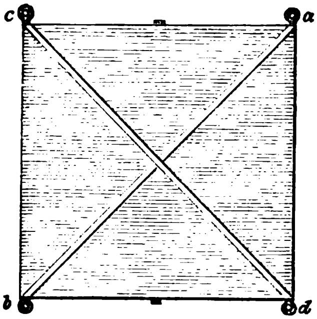
1349. The under frame of the sledge is made of three bars of iron, as represented in Fig. 144. These bars are 1½ inch broad, and ⅝ of an inch thick, and the two outer ones are made with holes at each end, as at *a*, *a*, *a*, *a*, for attaching hooks and chains for the horses dragging the sledge along. This frame is covered with the strongest description of sheet-iron, and over all is exactly five feet on the side of the square. The sheet-iron is of course strongly nailed to the three parallel bars; and in order to prevent the twisting of the sledge when pulled by horses, with a heavy plant on it,

FIG. 144.



we have two bars of iron, of the same dimensions as the others, fixed diagonally on the upper side, and above the covering of sheet iron, as represented in Fig. 145, from *a* to *b*, and from *c* to *d*, so that when finished, this sledge, as it lies on the ground and ready for use, is exactly as represented in the figure, and as specified, five feet on the side of the square. We may remark that last year, with this very simple mode of conveyance, we lifted and removed several trees, weighing, with their balls of earth, nearly four tons each, and that in the most safe and satisfactory manner.

FIG. 145.



1350. At first sight it may seem that there would be some difficulty in getting such a sledge put under the ball of a tree preparatory to removing it, but in practice this is not the case, as the sledge is so thin of itself, and yet so strong, that there is nothing easier than to get it under the ball, as the earth is removed from it. This is managed by first undermining the ball, on the side of the hole from which the plant is to be removed, pretty deeply, and then upwards under the ball, so as to give the bottom of the hole a slight slope upwards from the point of commencement to the centre of the ball, when the sledge is put under, and the other sides of the ball loosened, and then it can be easily slidden down the incline now formed by the sledge, till it is right on it. At this stage of the operation, the tree is fixed to the sledge by ropes attached to the stem, some eight or ten feet up, and from that point to the four holes provided in the ends of the bars of iron, and in which also the tackle for the horses is fixed for hauling. Previous to pulling the tree out of its hole upon the sledge, the earth on the outer circle should be dug away at that point by which it is intended to remove it, and of course this will be where the sledge was entered, so as to make an easy incline for the horses hauling it out. Arrived at the hole in which the tree is to be planted, it should be pulled in by an incline on the one side; and when the ropes are untied from the sledge, and the ball eased to one side by means of the ropes still attached to the tree, the sledge should be pulled out by an incline on the opposite side.

1351. I might refer to Mr Stewart M'Glashan's transplanter; but as I do not consider it constructed to lift large trees safely, I shall dismiss it at once by merely stating that it is not, in my opinion, adapted to lift large trees with tap roots, such as our hardwooded sorts have generally. The machine consists of a succession of spades, and seems well enough adapted to lift shrubs and such plants as do not have tap roots.

1352. In lifting large trees which have been previously prepared in the way recommended in the former section, care should be taken to open up the earth upon the outside of the light good soil which was put in about the roots; that is, no part of that good soil should be disturbed in the act of removing the tree, but it should be retained as part of the ball; and as the young roots will have pervaded it thoroughly, it will easily adhere, and therefore can be safely removed along with the tree. In all cases of transplanting large trees, the ground should, when damp, be made perfectly dry, by drainage, for their ultimate success; and where the soil into which the tree is to be planted is of a heavy clay nature, the hole should be made large in proportion to the size of the ball—say from four to five feet wider than the ball—and this space should be filled up under, around, and above the ball, with soil of a light character, which is always found more congenial to the growth and spread of roots than a heavy soil. At the same time, it is of importance to observe that, in the case of planting trees upon a stiff clay soil, the roots should be kept proportionally shallower in the hole than if they were planted in a light soil. There is often an error committed by planting trees too deep; for my own part, I never put more than about six or eight inches of soil over the top roots of large trees; and even in such circumstances, I have never had any disturbed by the winds, so often complained of by planters. Yet I never have used props of any kind, the weight of the ball being sufficient to keep the tree in an upright position against the effects of the weather on the top branches: this is the object gained by always removing a ball proportioned to the top of the tree, and in such a condition trees always thrive best. In putting the soil about the roots of a large tree, when having it replanted, I have found it of immense importance to its future health not to make it as put in too compact, as is too frequently done, and which is quite inconsistent with the laws of nature. My method of procedure in this case is as follows: When I have first about six or eight inches of the soil put in about the roots in the bottom of the pit, I have it given a good watering all over, making the whole, as it were, a thick mortar. This being done, I put in another layer of the same thickness, and again another watering alternately, until the whole is filled to the surface, when I give the whole a complete beating with a heavy mallet. By this plan the water causes the particles of soil to mix intimately among the roots, which has far more effect than any tramping. When the whole is finished, I turf the surface of the opening all over at once, and give a good watering over it: the turf thus soon begins to grow, and, consequently, excludes the drought better than any other plan which can be adopted. Indeed, it is of first-rate importance for the better security of the speedy growth of large trees when transplanted, to give repeated waterings over the surface of the ground above and about their roots, during the first four months after removal, and that more especially during very dry weather. As to the time of the year most favourable for transplanting operations, my opinion is, that any time between the 1st of November and the middle of April, while the weather is fresh, is alike favourable; observing, however, to transplant those kinds of trees first which come earliest into leaf in the spring.

1353. As to the kinds of trees best adapted for safe transplanting, I conceive that any kind whatever, if previously properly prepared in the roots in the way I have recommended, may be with equal success removed. The Turkey oak and the holly, when of large size, have been considered uncertain subjects for safe removal; but by judicious preparation they may be transplanted with as much hope of success as the lime-tree or the elm.

1354. It sometimes happens, in the case of large trees that have been transplanted, that they send out shoots from the crown of the roots, and from the surface of the stem—thus at once indicating that the constitution of the subject has received a violent check; and in all such instances, it will be at once observable that the top branches are not making healthy progress. In order to check this tendency, all such young shoots should be at once removed, in order to force the sap upwards; for if they are allowed to grow on undisturbed, they will appropriate a great proportion of sap to their own use as it ascends, and consequently deprive the top branches of due nourishment.

SECTION IV.—METHOD OF RENEWING THE HEALTH OF OLD OR DECAYING TREES.

1355. As it is sometimes a matter of very great importance to those who have the management of the home-grounds of landed proprietors, to know what can best be done for the preservation and improvement of favourite ornamental old trees, it may be useful to some into whose hands this book may fall, to be made acquainted with the method of adding new vigour to the impaired health of such trees. In the present section, therefore, I shall lay down my own manner of procedure in such work.

1356. Wherever it is desirable to have a tree that may be in a declining state resuscitated, or renewed in health, the first point in the operation is, to have all dead branches cut clean away, and that as far back upon each branch as to remove entirely all decidedly dead and decaying portions, till the healthy wood appears at the cut parts. Next, the stem of the tree, as well as all the larger branches, should be scraped clean from all moss that may be growing upon their surface; and all the parts scraped should be well washed down, beginning at the highest part, with a brush and cold water, observing to make the bark perfectly clean. That being done, a trench should in the next place be opened all round, cutting the roots in the same manner, and at the proportionate distance from the stem, already described in treating of preparing trees for transplantation. Supposing, then, that the roots have been cut in, say six feet from the stem all round, making the diameter of the ball of earth about the bottom of the tree twelve feet, exclusive of the stem itself, the trench immediately upon the outer circle of the ball should be made from five to six feet broad, and as deep as to cut every root attached to the tree down even under the subsoil, and as far as they may be found to exist, without having any respect to rule in this point. In throwing the soil out of the trench, the workmen should be instructed to lay all the good portion (which may be the upper stratum) immediately upon the outer edge of the trench opened, which will, in such a position, be ready for mixing among any better soil that is afterwards to be put in. Beyond the good soil thrown out, all bad portions should be thrown, and immediately carted off, before commencing to fill in the trench about the roots again. The trench being made of the proportions above stated, and all bad quality of soil removed, the next thing is to have a mixture of the following kinds and proportions of soils brought forward, and which, it is presumed, has been previously in readiness for the purpose:—One part well-rotted cow-dung, two parts half-decomposed leaf-mould, and one half part powdered lime; or, in other words, to one barrow-load of well-rotted cow-dung, and two of half decomposed leaf-mould, add one half barrow-load of lime in its powdered state, and in the same proportion whatever quantity may be required. A compound of the above description being previously prepared, and a sufficient quantity of it brought forward, have it mixed up with an equal quantity of the good portion of the soil which was thrown out of the trench, and have the opening or trench entirely filled up with this mixture; observing in this case, as well as in the case of transplanting the large trees formerly referred to, to give plenty of water as the filling in of the new soil proceeds, and to give a moderate tramping with the feet also. When the trench has been filled to the level of the surface of the surrounding ground, have the turf, growing upon the surface of the ball between the trench and the stem, pared off to the depth of about four or five inches, which turf may be thrown back on the top of the new soil; and over all this have again about eight inches of the compost spread over the whole extent from the stem of the tree to the outer circumference of the trench, making the ground upon that part eight inches higher than the level of the surrounding ground; and after a good watering and tramping, the whole operation is finished.

1357. In order to encourage as healthy a state of the trees as possible, it is of great advantage to syringe repeatedly, and keep clean the bark, by means of a brush and cold water, in the summer season; and even, in the event of a continued tract of dry weather, to give repeated waterings at the roots, more especially over the new soil put into the trench, where of course the young roots will be making rapid progress. By such a system of treatment, I have seen old trees, which to appearance were rapidly decaying, recover, and assume quite a renewed state. Some time ago I operated in this manner upon some very fine specimens of old hollies which appeared to be decaying, and which have been vastly improved by the operation; and from what I have seen in the case of other subjects formerly treated in the same manner, I feel confident that the health of many old trees might again be established by attention to the mode of recovering them here described.

1358. In all cases of resuscitating old trees in the manner above advised, it is of the greatest moment to have a drain made all round the bottom of the trench before putting in the compost; for it sometimes happens, more especially if the original soil be of a heavy character, that water will lodge in the bottom of the trench; and by simply making a drain, and leading it away by a proper outlet, any danger of this kind may be prevented. If water were allowed to lodge, the tree would, instead of improving, decay more rapidly than if it had never been interfered with.

1359. In the course of my visits to landed proprietors' seats, I have seen many old and ornamental trees which could be much improved by dealing with them in the manner above detailed; and it is on this account I have given these few hints for the improvement of such. Still, in order that proprietors may not be too sanguine on the point under consideration, I may state that there is a stage of unhealthiness and old age at which trees may arrive, which will render them quite unfit for being recovered, whatever means may be used for that purpose, discrimination being necessary on the spot.

SECTION V.—EFFECTS OF UNDERWOOD ON THE HEALTH OF TREES IN A PLANTATION.

1360. By the term *underwood*, is implied bushes of a woody habit growing under timber trees. It may consist of two kinds—namely, perfect plants of a naturally low and branchy character, as the privet, rhododendron, holly, &c.; or shoots issuing from the stocks of trees which may have been cut down in thinning, as in the case of neglected coppice. In whichever of the above forms underwood may be found in a plantation among growing timber trees, it is capable, under certain circumstances of management, of becoming of much ultimate good or harm to the health of the trees under which it may be growing. In a plantation of considerable extent, if underwood be allowed to grow up in such a profusion as to impede a free passage of air through the trees, its effects must be of the very worst description, and must ultimately be productive of many premature deaths among them ; and even those that may grow up healthily, must afterwards be found inferior in the quality of their timber, from the want of a proper amount of air by which perfectly to mature the wood. On the other hand, a plantation of trees of rather small extent, more particularly if upon an exposed and high-lying situation, is much improved in health by having a well-regulated quantity of underwood growing among the trees, more especially if that is planted upon such points as are most exposed to cutting winds. But even in such situations, an injudicious quantity of underwood would certainly prove injurious to the health of the trees ; for let it be understood, that most plants of the character of underwood naturally emit a great quantity of fibrous matted roots, which have the effect of impoverishing the soil to a great extent, and also of excluding a due portion of air from the roots of the trees under which they grow. In the introducing, therefore, of underwood into a plantation among trees which are wished to be kept in a healthy state, judicious management is required.

1361. A due proportion of well-chosen plants as underwood, is in all cases both ornamental and useful in a plantation, and may be attended with the very best effects ; but an over-quantity is in all cases void of ornament, indicates confusion, and, instead of being useful, becomes a nuisance both to the proprietor in seeking after recreation, and to the forester while in the act of removing his trees. Having now merely adverted to the effects of underwood upon the health of trees in a plantation, which was all I aimed at in the present section, I shall in the next point out how underwood may be managed for the health of trees, and at the same time point out the plants best fitted for the object in view.

SECTION VI.—KINDS OF PLANTS BEST FITTED FOR UNDERWOOD, AND HOW THEY MAY BE PLANTED IN A WOOD SO AS TO PRODUCE USEFUL AND ORNAMENTAL EFFECT.

1362. Having in the foregoing section made a few remarks as to the effects of underwood in plantations, and shown that it may be made to produce either good or bad effects, it still remains to be indicated how the plants generally termed underwood may be disposed of among trees so as to prove both useful and ornamental. But before doing so I shall give a list of the different kinds of plants which are known to thrive under the shade of trees, and are therefore termed underwood.

Names of Species.	Nature of Soil in which they thrive best.
AUCUBA JAPONICA,	Any loamy soil, if dry.
LAUREL BAY,	Ditto.
BOX TREE,	Ditto.
DOGWOOD,	Ditto.
IVY,	Bare rocky parts.
HOLLY,	Rich loam.
PORTUGAL LAUREL,	Ditto.
EVERGREEN PRIVET,	Ditto.
LAURUSTINUS,	Ditto.
RHODODENDRON,	Peat soil.
JUNIPER,	Very light sandy soil.
YEW TREE,	Sandy loam.
ARBORVITÆ,	Ditto.
BUTCHER'S BROOM,	Ditto.
ALDER,	Ditto.
SCOTCH ROSE,	Rich loam.
MAHONIA AQUIFOLIUM,	Ditto.

1363. The above-named are the most important of the class of shrubs generally called underwood; and these are, with the exception of the dogwood, alder, and Scotch rose, all evergreens. In planting any of these shrubs with a view to produce shelter upon any given point, the holly or alder should be chosen, because they are the most hardy for that purpose. Where it is wished to cover any bare rocky part in a plantation with the view of forming cover for game, and of producing an ornamental effect at the same time, the ivy, juniper, yew tree, and Scotch rose should be planted, all these thriving well on such parts; and where general groups of underwood are wanted anywhere along the sides of forest-rides, the other sorts may be used.

1364. The common system of planting underwood is that of scattering promiscuously among the trees individual specimens, without any regard to order. To this system I object, because it is neither of an ornamental nor a useful character. I am aware that this is done with the view of producing a general cover throughout for the protection of game, but it is seldom that the plants so dealt with grow so well as either to form a respectable cover, or to be ornamental as specimens; and, besides, where underwood is found thus generally scattered over a plantation, it has more the effect of retarding and interrupting the progress of the proprietor and his friends while going through, than of adding to their recreation. I would therefore advise, as an improvement on this point of forestry, the following method, which is decidedly both ornamental and useful:—First, upon any exposed point, where it may be advantageous to have underwood grown for the purpose of producing shelter, have hollies planted, say at eight feet apart, and made up between with firs to four feet over all. The firs will have the effect of producing shelter to the hollies for a few years, and thereby cause them to grow up more quickly than they would do otherwise; and as the nurses advance upon the others, they can be thinned out and gradually dispensed with altogether. If the situation happen to be one too much exposed to allow of hollies attaining a useful and ornamental size, and yet one where it is particularly desirable that underwood should be, plant birch, which will be certain to grow well and form underwood, while upon more favourable parts the holly may be planted as above stated. Second, where underwood is wanted in the interior of a plantation, either for the purpose of cover for game or for ornament, plant groups of laurel bay, holly, Portugal laurel, and evergreen privet; keeping each kind separately in a mass by itself, to the extent of from one-sixteenth to one-eighth of an acre. Where such masses are planted, the trees should be almost altogether dispensed with, leaving perhaps only one tree in the centre of each mass of evergreens; for let it be understood, that although the plants above named will generally grow under the shade of trees, they are more likely to live long, and become bushy, healthy plants, when the trees are kept well off them. Third, at convenient intervals along the sides of the forest-rides, have groups of various sizes planted, giving these various bendings of a natural character, like plots in a flower-garden; and at well-chosen points of view from the roads, have slight openings made, so that masses of evergreens in the interior of the wood may be brought into sight. In thus disposing the underwood plants into masses, care should be taken to keep all the low-growing sorts next to the rides—that is, such as the rhododendrons, mahonias, roses, laurustinus, and aucubas; and in order that a natural variety may be produced by the plants of each species being congregated in a mass, two or three arborvitæs may be put in as prominent plants in a group now and then, which would produce a pleasing and graceful effect;

while, in some cases, a tree growing in the centre of such a group might be clothed with ivy, which has also a graceful effect in a wood.

1365. Having thus briefly stated my views as to the disposition of underwood in plantations, it yet remains for me to show the advantages of such a system over the usual way of planting them without any regard to order. Where bushes of any kind are found growing as it were at random, in a plantation among trees, they have in all cases the effect of retarding arboricultural operations, and that to a very great extent, as I have myself often experienced; and, besides, they have a great tendency to prevent a free current of air passing through among the trees, causing, as it were, a stagnated state of air. Now, by the system of growing underwood in small masses as I have recommended above, these bad effects are prevented; for, as it is understood that these masses are to be grown at pretty wide intervals, the air will have free access to all the trees growing in the spaces between them, and wood operations can at the same time be carried on without interruption. Again, the proprietor and his friends, when in pursuit of game, can have no straggling thickets of bushes to annoy them; but when any of the covers are beat, they have open and uninterrupted spaces between each group; while the underwood, in consequence of being planted in masses, with few trees in their immediate vicinity to injure their growth, will be much more bushy, and will form a better cover than bushes scattered singly over the ground. In an ornamental point of view, the system which I here recommend is infinitely superior. By having shrubs planted singly and at random over the ground in a plantation among trees, there is a continued sameness and confusion presented to the eye; but when planted in well-defined masses, each species by itself, there may be made a continual and never-ending variety in the scene; for the eye, instead of resting upon a confused sameness, at once alights upon a beautiful and compact mass of foliage, having its outline perfectly portrayed on the space beyond among the tall trees, beyond which another mass may appear in the distance. This part of forestry is generally too little attended to, and that for no other reason than that taste is required to bring it out; but I am glad to say that this state of things is fast improving.

SECTION VII.—FENCING OF PARK TREES, SO AS TO PROTECT THEM FROM DEER, HORSES, CATTLE, ETC.

1366. There are few landed proprietors' seats in Britain so perfectly adorned with all the known ornamental and useful sorts of trees, that they may not now and then receive an additional embellishment in the form of some new and highly interesting foreign species. Indeed, however complete any proprietor's home parks may be as to its collection of useful and ornamental trees, if he is of a highly refined taste, he will frequently take pleasure in transferring good specimens from the enclosures of his shrubberies, &c., where they were almost hidden from view, to the open parks, where they are sure to develop themselves to advantage, and prove in no small degree ornamental, by their contrast with other larger and more common sorts, when judiciously arranged among them. In order to protect such specimens from being injured by cattle that may be grazing on the park where they are planted, it is of primary importance for their future welfare that they have a fence of some sort put about them for a time at least. It is more particularly under such circumstances that I would here recommend the fencing of trees on a park; for it must be admitted, that a tree growing without any protection whatever, is in all cases a more agreeable object than one having a fence about it. Wherever, therefore, it is found necessary to have single trees protected for a time from the effects of animals roaming about them, that should be done upon the most ornamental principle that can be devised.

1367. There are various methods and forms practised for the protection of single trees—from the simple wooden posts with rails, to the neat and highly ornamental, and, I may say, almost invisible, fence of iron. It would be altogether superfluous to enter into detail here upon all the varieties of fences, or *guards*, as they are sometimes called, in general use for protecting single trees. I shall therefore confine my observations to the description of three sorts—namely, the octagonal, the square, and the circular.

The names, as given above, merely indicate the shape of each sort; therefore, in order to illustrate their size and general construction, it will be necessary to give a figure of each, with a few remarks subjoined, relative to how they are applied in protecting trees, the materials of which they may be made, and the expense of erecting in each case, according to strength and height.

1368. Fig. 146 is a plan of the octagonal form of tree-guard, as we have had them made for protecting very young specimens on the lawns of many proprietors; and it is an exceedingly ornamental form when well made. We make them of small larch thinnings, in the following manner:—

The tree is planted in the centre of the octagon, as shown at *a*, in Fig. 146, and also at *a* in Fig. 147, which last is a section of the side elevation of the plan. The open circle about the tree is marked off upon the ground about two feet in diameter, around which small posts are driven in so as to form an octagon in that part, as at *b*, in each figure. These posts may be from two to three inches diameter, according to the strength required, and from twelve to eighteen inches high above ground. The eight small posts being driven into the ground so as to form an octagon of about two feet diameter, corresponding ones will next require to be driven in upon the outer circle, as shown in each of the two figures at *c c*: these may also be from two to three inches diameter, and from two to three feet high above ground, according to strength required; that is, according as there may be sheep only to guard against, or deer, &c. The octagon being formed by the posts being driven in both upon the inner and outer circles, and the diameter of the figure made, measuring from any two of the extreme points, say ten feet, the next part of the work is to have bearers nailed on between each corresponding pair of posts, as shown in each of the figures at *d d*. These may be of the same strength of wood as the posts upon which they rest their ends. Next, a top rail is to be nailed on the outer posts, as at *e e*, in each of the figures, all round, so as to bind the whole together, which top rail we shall suppose to be two and a half inches diameter. The other three courses of rails, as shown at *f*, *g*, and *h*, should be made proportionally of a smaller size as they recede downwards to the centre, which gives the work a neater and lighter appearance than if the whole were made of one dimension. In the figure above, there are only four horizontal courses of rails shown; but in this matter the taste of the proprietor may be consulted; at the same time keeping in view, that if the eight spaces forming the outer boundary of the octagon are not made proof against the encroachment of sheep, the horizontal spars upon the inside slope must be made so; and also that, if it be found necessary to make the octagonal guard proof

Fig. 146.

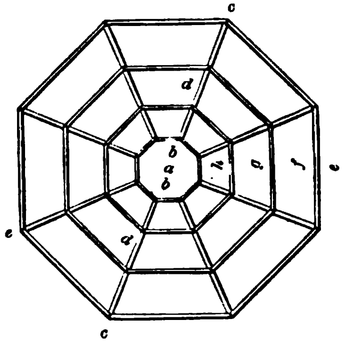
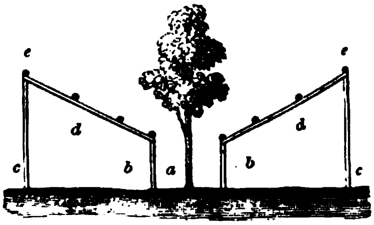
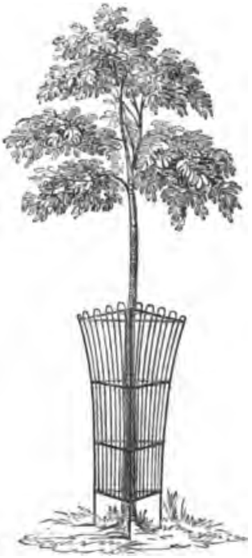


Fig. 147.



against the encroachment of rabbits, hares, &c., that is very simply attained by driving in a few extra small posts on the inner circle forming the octagon immediately about the tree. The eight squares forming the outer boundary of the octagon may be made of an ornamental character, and of any design the taste of the proprietor or his forester may suggest. As to the merits of this description of tree-protector, besides being very ornamental, it is of all others the best adapted for the admitting of free and unconfined space about a young plant; the whole body receding from the plant, as it were, and yet producing perfect protection at the same time. I would, therefore, recommend it before all other forms for young specimens requiring free and open and unconfined space for the development of their branches. In parks where large cattle are grazing, the diameter of the octagon should be increased, so as to prevent them from reaching the branches of the plant; and in such a case, in order that the grass growing upon the ground occupied by the octagon may be made serviceable to sheep, it is only necessary to leave open the spaces between the posts forming the outer boundary of the figure. The expense of erecting octagonal tree-protectors is but trifling; for the wood being laid down, a man will easily make one in a day.

FIG. 148.

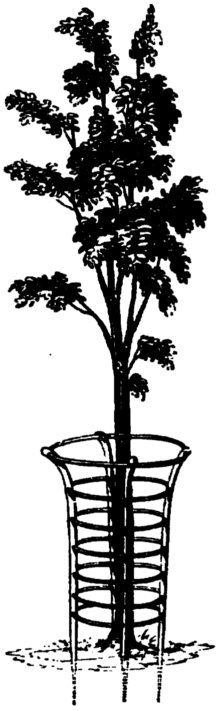


1369. Fig. 148 represents the square, or four-sided form of tree-protector, which is not adapted for very young trees, but for trees of a considerable size only, and such as have a stem free of branches. They may be constructed of small larch thinnings, as in the former case, and of any convenient strength, according to the kinds of cattle to be kept back—say of wood, two inches diameter, and three feet high above ground for sheep, and of two and a half inches diameter, and from four to five feet high for deer, horses, or oxen. The spars may be put in all vertically, or with four uprights, one at each corner, and having others nailed on at convenient and proper distances horizontally, according as taste may suggest.

In erecting these, care should be taken to keep them at least six inches from the stem of the tree at any given part; for if put too close on, animals will sometimes gnaw the bark through between the spars, or strip it off with their horns.

1370. Fig. 149 represents the circular form of tree-protector, and is adapted for trees of a considerable size only, as in the case of the square form, already referred to. They are sometimes made with spars altogether vertical, having a hoop to bind them together on the top, and sometimes with four or more upright posts driven into the ground, bound by hoops at regular intervals between top and bottom, as in the case of the figure here given—this, of course, being altogether a matter of taste. Both the four-sided and the circular forms of tree-protectors are of very simple construction, and may be made by any forester by means of small larch thinnings from the young plantations; and any active man will make at least six in a day. In what has been stated above relative to tree-guards, I have considered them to be made of wood only; but where a superior style is an object, they should be made of iron, painted green, so as to make them almost invisible at any considerable distance. Made of iron, they could not, of course, be so neatly done and fitted up by any forester; therefore those proprietors who wish to have tree-guards of an elegant, light, and airy appearance, I would recommend to apply to Messrs Young, Peddie, & Co., iron manufacturers, Edinburgh, who keep on hand, for the purpose, a great variety of beautifully-fitted-up articles of the kind, at various prices, according to strength and height, &c. I have at present one of the catalogues of the above-named firm before me, in which the prices of the tree-guards of the square and circular forms are stated at from 10s. to 15s. The octagonal form is not, however, mentioned in their list now before me; but I should suppose that, to make it of iron, it would cost at least 60s.

FIG. 149.



SECTION VIII.—HOW TO PREVENT DEER, HARES, AND RABBITS FROM INJURING YOUNG TREES.

1371. On most estates where game are preserved to any considerable extent, there is often experienced, especially in the neighbourhood of the home grounds, great difficulty in getting a crop of young trees to succeed satisfactorily, in consequence of hares and rabbits eating their bark and young branches; and in parks kept for deer, during severe winters I have often seen these animals, if not well supplied with food, gnaw the bark from old trees, much to the injury of many fine healthy specimens.

1372. I have so frequently been asked by proprietors and their foresters as to how young trees may be best preserved from the attacks of hares and rabbits in a plantation, and as to how deer may be prevented from eating the bark from older ones, that I have of late devoted my attention especially to the subject, with the view of giving my experience on it in this work, and I am now prepared to state the result of such experiments as I have made.

1373. The first experiment I made was on a plantation of oak, planted at fifteen feet apart, with larch as nurses to five feet over all. It was of some thirty acres in extent, and the oaks were strong plants, from thirty to thirty-six inches high. I had it planted in the month of February, and in ten days after I found a very considerable number of the oak plants had been injured by hares eating the bark from the stems, and also the young and tender shoots of the former year's growth. As I knew, however, that hares were plentiful in the neighbourhood, I did not delay, after seeing the first symptoms of their attacks on the trees, to adopt some mode of preventing their further ravages, and therefore immediately set about preparing different mixtures for besmearing the stems and branches, as the only mode that seemed to afford hope of success. No doubt, the most effectual means to prevent further injury to the plants would have been to destroy the animals that did it, but as this mode did not meet the views of the proprietor, I had to adopt such means as remained.

1374. I had, therefore, hogs'-lard and train-oil mixed together, to the consistency of thick cream or common paint, as one mixture; and as another, I tried fresh cow-dung and coal-soot, adding a little water to make it thin enough to admit of it being applied to the trees with a brush; a third mixture consisted of hot lime with water, also made up to the consistency of thick cream or common paint.

1375. Having got these three mixtures prepared, I had about one half of the extent of the plantation marked off for experimenting on. Three men were engaged, each with a separate mixture for application to the trees; and as I wished to apply each mixture to the trees on a given portion of the ground laid off, I divided it into three portions of about five acres each, and directed the men each to take one of the portions, and to besmear all the oak trees on it on the stems and principal branches. Each of them, with his separate mixture, finished his portion in five days; so that, altogether, the operation over the crop of oak on fifteen acres did not cost over two pounds.

1376. I now watched the effects of what had been done, and soon found that the painting had the desired effect of preventing the animals from further injuring the trees operated on. Accordingly I had the oaks on the other half of the enclosure also gone over, but only partly with the lime mixture, and partly with that of the cow-dung and soot, as I thought it probable that the mixture of oil and hogs'-lard might prove prejudicial to the health of the trees painted with it, and therefore did not wish to operate on more with it till experience showed whether my opinion regarding it was correct or not.

1377. I mentioned that the crop on which the experiment just described was made, was planted in the month of February, and I may add that it was about the end of March before the painting of the trees in the way set forth was finished. I observed that the greater part of the lime mixture had been washed off the trees by the month of May, that the cow-dung mixture was also washed off by the middle of summer, and that the oily mixture adhered to the trees on which it had been put in nearly as fresh a state, when I examined them in the month of November afterwards, as when it was applied. I also observed at that time that the trees which had been operated on with the two former mixtures had prospered well and made some progress in growth, while those to which the last had been applied, were, as I had anticipated, stunted and unhealthy-looking; this proving that an oily substance, although it adhere to trees, and has the effect of preventing animals injuring them, still, from its bad effects in closing the pores of the bark and preventing its healthy action, is not adapted to the purpose under notice, and accordingly I have never used it since.

1378. At the time referred to above, however, when the winter had set in upon the young trees for the first time after they had been planted, and when the hares began to lose the fresh herbage of the fields, they were found again at their former work upon the trees. The damage they were doing did not happen to be observed till they had a considerable number of the young trees completely destroyed; but as soon as the discovery was made, no time was lost in again applying the former mixtures of lime and water, and of cow-dung and soot. At this season of the year, however, it was found that the action of the rains and frosts prevented the mixtures from adhering so well as they did in the drier months of the spring; I was thus obliged to apply frequent fresh paintings as the old ones were washed off, which became very expensive in the long run.

1379. The result of the foregoing experiment may be summed up thus: That hares and rabbits may be prevented from eating the bark and young shoots from young trees by the frequent application of the mixtures described, but that the operation is so expensive as to make it desirable that the animals should be destroyed rather than incur such expenditure, at least where there is a large extent of plantation to be operated on. Where only a few trees are to be protected the case is different, and the process may with propriety be persevered in till they are so strong as to be out of danger.

1380. Being satisfied as to the result of the experiment now described, the next one I made on the subject under notice was on trees standing in the park at Castle Grant, in which there is a large number of deer, both of the red and fallow sorts. In this park the timber is partly old ash, oak, sycamore, beech, and elm, and partly the same sorts about forty years old. In the winter of last year and the spring of this (1860), the weather has been so severe, that from the month of November last up to the 1st of March, the ground has been under one uninterrupted covering of snow, and thus the deer have been sometimes pinched for food, which caused them to attack the younger class of trees in the park. This they did in a systematic manner; some two or three of them commencing to one tree, and not leaving it till they had the bark completely stripped from it as far up the stem as they could reach. In this way some ten of the trees were injured before we became aware of what was going on. As soon as the mischief was observed, however, I had a mixture of cow-dung and soot prepared, which was applied pretty thickly to the stems of the younger class of the trees, as far up as appeared necessary; and since this was done we have had no more of them interfered with—a result which shows that such a mixture is as effectual in repelling these animals from trees as it is in regard to hares with younger plants.

CHAPTER XII.

SECTION I.—HINTS IN REFERENCE TO THE FELLING OF TIMBER.

1381. In the sections on the thinning of plantations, enough has been said in regard to the mode of felling I recommend for small trees to be removed from the respective crops; and, therefore, I need not again recur to that branch of the subject, but proceed to give a few short recommendations in regard to the felling of large trees, or such as may be properly called TIMBER—a designation which embraces all trees that will measure six inches on the side of the square, and upwards.

1382. In felling timber trees, whether thinnings from a plantation of considerable age, or a matured crop to be cleared, the operation may be performed either by the proprietor's own woodmen by day labour, or by a party to whom the work may be let by contract, according to the special circumstances of the case.

1383. If the timber to be felled is thinnings from a plantation of valuable and promising trees, it will generally be found most desirable to have the work done by the proprietor's own servants, and under the eye of the forester or his foreman, who are more likely to see that the felled trees do not injure the standing ones, than another and a strange party would be.

1384. When the timber to be felled is a clearance of old and matured trees, it will be found more economical to have the work done by contract than by employing men by the day; and this sort of work may be contracted for either at a certain rate per tree, or at so much for the cutting of the whole number of trees to be felled.

1385. I have often seen serious disputes arise betwixt proprietors and wood merchants, when the former sold their timber to the latter on the understanding that it was to be felled for them in a certain manner, and within a certain time; and, therefore, strongly recommend that no proprietor should undertake to fell trees as a clearing for a timber merchant, as if he do, the timber merchant will, in all probability, discover ways and means to find fault either with the mode of doing the work, or in regard to the time specified, and consequently manage to have the price of the timber reduced on such a pretext. The better way, therefore, is to arrange that the timber merchant shall cut, manufacture, and carry away his trees himself, and to bind him to do the work of felling to the satisfaction of the forester, and within a given time.

1386. When timber is sold by measurement, at a certain rate per cubic foot, a proper and clear understanding should be entered into, as to—first, the allowance to be made for the thickness of the bark; second, what size of branches are to be measured as timber; third, how far out to the small ends of the trees the measurements are to be taken; fourth, the allowance to be made for any unforeseen rot or other deficiency in the trees; and fifth, whether the branches are to belong to the proprietor or the timber merchant. On all these points I have seen very important disputes arise; and I therefore think it necessary to record the fact here, that unless in the case of selling by measurement, the forester guard himself by previously entering into a proper understanding with the wood merchant on all these points the latter will easily take advantage of the former, and, in all probability, manage to make himself right in the dispute. All disputes on the points specified can, however, be obviated by selling at a certain rate per tree, or at so much for the whole lot of trees to be disposed of; and under skilful valuation I have generally found this the better arrangement for all parties.

1387. Whether timber is felled by the proprietor's own woodmen or by the purchaser, the forester should compel the parties to cut the trees as low as possible, both in order to insure the largest possible quantity of timber being realised from them, and to present an even and equal surface of the ground after the timber is removed. This can be always accomplished by clearing away from the bottoms of the trees with a spade the turf or earth that may be likely to interfere with the axe and saw in the operation of felling low, and by hewing well down with the axe all the tops of the roots standing up and projecting above the ground, and forming the junction with the stem. This should be done to such an extent that the circle of the stem of the tree to be felled shall be equal down to the earth, when it can be cut through with the cross-cutting saw in the usual way.

1388. Singular as it may seem that timber merchants should fell their trees in such a way as to leave from six to twelve inches of the bottom timber of each standing above ground on the stocks, still it is a fact that they generally do so when left to themselves in the department of felling their trees off root. This arises, perhaps, partly from their want of knowledge in that branch of timber manufacture, partly from their being imposed upon by the men to whom they let the work, partly from a careless habit, and partly from a desire to have the work done on the cheapest scale possible; as it must be admitted that to do the work properly, as described under paragraph 1387, the trees will cost more than when done in an opposite way. Still, I have often been surprised to see the want of foresight shown in such cases; and I refer to it in order to prepare foresters for looking after their employer's interests in this branch of forestry; as it must be kept in view, that, in felling a large tree, if six inches of the bottom is left on the stock, this will, in all probability, lessen the value of it to the extent of the price of one foot of timber; which, in a plantation of some thousands of trees, will amount to a loss more than the forester's yearly salary; hence the necessity of attention to such seemingly small matters.

SECTION II.—THE APPLICATION OF WATER AND STEAM POWERS TO THE MANUFACTURE OF TIMBER.

1389. On any property having a large extent of woods, it becomes absolutely necessary to have some power or powers established for the conversion and manufacture of the timber as it falls to be disposed of; such power is obtained from machinery, propelled either by water or steam, according to circumstances.

1390. Where there is a large extent of wood to dispose of, at and approaching maturity, and where, in its neighbourhood, there is a water-run of sufficient magnitude to propel sawing machinery, it will be generally found most economical to make use of such a power, as a given amount of power is more simply and cheaply secured from the application of water to a large wheel than it is from that of steam machinery, which is always complicated, and therefore more expensive than a simple water-wheel, both at the outset, and afterwards to maintain in perfect working order.

1391. In our Strathspey forests, we have ten saw-mills propelled by water, and four by steam. The former are situated in those parts of the forests where there are streams of water suitable for the purpose of driving such machinery, and where there is a supply of timber sufficient for manufacture for a considerable number of years; while the latter are stationed in parts of the forests most distant from water-runs, and where the supply of timber is comparatively small, and not likely to last for many years; these are all of a fixed character.

1392. Fixed sawing powers are, however, in many cases disadvantageous for the manufacture of timber, and this must always be the case where the several plantations on a property are each comparatively small; as, from the sawing power being stationary, there can be no great supply of timber got for it without a great outlay in carriage. When considerable distances, therefore, intervene betwixt the plantations, and where they are each comparatively small, it becomes desirable to use what may be termed a portable steam sawing power; whereby the sawing power may periodically be placed near the timber, at no great cost for change of position, instead of the masses of timber being carried to the sawing power.

1393. Whether a fixed water-power, a fixed steam-power, or a portable steam-power, should be used, will always depend upon the nature and character of the woods to be operated on, as well as upon their relative extent and position. Where the supply of wood to be manufactured is likely to keep good for a considerable number of years, where there is a plentiful supply of water, and where the carriage is not likely to exceed a distance greater than from one and a half to two miles at farthest, it is better to use a fixed power than a portable one; as, generally speaking, a much cheaper power can be applied from a fixed engine than from a portable one, and, besides, the former is generally more easily maintained than the latter, and less likely to get out of order.

1394. Where the plantations are each comparatively small, and where they are far apart, it will be found advantageous to use a locomotive steam-power for manufacture, which can be removed from one plantation to another as wanted.

1395. The advantages of proper sawing powers in large woods to be cut down are immense; wherever these are not provided, the price realised must be small. Where there are large tracts of wood without sawing powers for conversion and manufacture, the principal obstacle to the ready sale of the timber is the great amount of outlay necessarily incurred by the purchaser for its removal in the original rough state, and at the same time his incapacity to get rid of a great bulk of what is to him useless wood, in the form of the outer slab. Where the purchaser has the use of a sawing power on the ground where his wood is cut, this obstacle is done away with, and he can, with comparatively little trouble, relieve himself of all the valueless portion of his purchase, and at once convert it into a proper and marketable state.

1396. A very great advantage gained by the proper and judicious application, whether of steam or water power, to the manufacture of timber, is that of converting even the refuse of the trees—slabs and tops—into useful and saleable purposes, such as staves and small boards for packing-boxes.

1397. The cost of sawing powers varies according to their capability to do work. Generally speaking, however, a good fixed saw-mill, propelled by water, and of twenty-horse power, may be erected for about £500. A fixed steam-power, of similar capabilities, will cost from £600 to £700, or even more, according to circumstances; while a good portable one of similar power, with mill-sheds and machinery complete, may cost from £800 to £1500, according to the quality of the materials used in constructing it, and according to its capacity and convenience.

SECTION III.—SHOULD LANDED PROPRIETORS MANUFACTURE THEIR OWN TIMBER?

1398. The heading of this section is a question that has so often been put to me of late by proprietors, that I think it desirable to answer it by treating the subject of it as a separate section, and in this to record my opinion for the use of all into whose hands this work may fall.

1399. I have known cases in which proprietors who manufactured their own timber for sale, realised a greater amount from it in this way than they did by selling it in the round state to timber merchants; but for every one such case, I have known ten in which the proprietors lost heavily by manufacturing on their own account, and in which they realised double the annual amount from their woodlands after abandoning the manufacture of their timber, and adopting the plan of selling it in the round state to timber merchants, who manufactured it for themselves.

1400. This will appear evident, when I point out that any proprietor, in manufacturing his own timber, must at all times be subject to the guidance of his servant who has the management of such an establishment; as it is not understood nor expected that he is either to do the work or make bargains in regard to it himself. From this it follows, that if a proprietor is so fortunate as to secure the services of a really judicious and skilful person to superintend the management of his wood manufacture, he may be able to realise the highest possible return from it, and that if he should be so unfortunate as to put the establishment into the hands of a man of an opposite character, he is sure to lose by the transactions to a very large extent, as I have very often had occasion to witness.

1401. Not long since I was called out to inspect the woodlands on an extensive property, and, after examining them, I found them in the worst possible condition, from large quantities of comparatively young trees having been injudiciously cut down from the young and growing plantations, for the purpose of supplying extensive orders that had been received at the saw-mills, several of which were established on the property, and kept in the proprietor's own hands. The forester had the management of them, and made all bargains in respect to the sales of the timber manufactured at them, as well as directed the cutting of the trees in the woods for this purpose; and this had gone on for several years previous to my visiting the place.

1402. On further examining into the state of this establishment for the manufacture of the proprietor's own timber, I found that a large amount of expenditure had been incurred every year in the carriage of the timber from the different woods to the saw-mills, and that all the work had been done by day-labour; the result being that from several thousands of acres under valuable woods, only about £1000 per annum of clear income had been realised.

1403. As the results of this establishment to the proprietor were quite in keeping with those of many others of the same sort which I had previously examined, I think it right to show more particularly how such establishments are generally conducted, and especially how it was that the one referred to did not result more satisfactorily than it did, which will cause the example under notice to stand out as a beacon to other proprietors, who may find themselves similarly circumstanced in regard to their saw-mills.

1404. I found that the horses kept for the carriage of the trees from the woods to the mills were the proprietor's own, and fed at a high rate of expense; that they brought but light loads from the woods, and seldom wrought when the weather was wet, or such as the men with them could not work comfortably in. The men engaged cutting the trees in the woods were paid by the day; a certain number of them were kept regularly employed in this way; and they assisted in loading the carts as they arrived from the mills. In the mills I found that the sawyers were also employed by the day, that they stopped the work of sawing always when the carts with the wood arrived, in order to assist in unloading them, and that every man took the work quietly and easily as it best suited his comfort. Now, let us compare this state of things with that of another saw-mill establishment which I visited the other day, and which is kept by a timber merchant who purchases wood from ourselves, and manufactures it upon his own account.

1405. I found that he kept no horses of his own, but contracted with a party who kept them, for the carriage of all his timber from the woods to the mill, either at a certain rate per tree, per ton, or per cubic foot. He also contracted for the felling and pruning of all his trees in the woods, at a rate per tree, or per foot, and had nothing to do with the loading of the timber on the carts. In the saw-mill I found every individual striving to his utmost in his own department of the work, all the cutting up of the timber having been contracted for at a price per 1000 superficial feet, according to the thickness of the boards, &c., or at so much per sleeper, &c. &c., every part of the work being conducted in this way.

1406. The difference in the modes of working, as explained in the two preceding paragraphs, at once shows why the saw-mill establishment of the landed proprietor was so expensive, and why he did not realise so much income from it as he should have done. It was because his servants made the whole work subservient to their own comfort, and did not study his interest, but their own ease. And yet the men employed did not realise nearly such a high rate of wages as those employed by the wood merchant did; and the latter class was really more comfortable than the former. The proprietor's men had only 2s. per day, while the wood merchant's made from 3s. to 3s. 6d. each. In short, the timber merchant's establishment was conducted upon a sound and economical principle, while that of the proprietor was not; hence the former made a considerable profit from his timber, even after paying a high price for it, while the latter did not realise more than the half of the real value of his wood. This, I think, is enough to point out that, unless a saw-mill establishment be properly conducted, it is more likely to become a loss to its proprietor than a gain; and I should, therefore, at once give it as my opinion that proprietors, unless they can secure the services of really experienced, judicious, and efficient men for the manufacture of their timber, should on no account undertake it.

1407. I am prepared to prove that, generally speaking, it will hold true, that a proprietor of woods will realise more from them by selling his wood in the round state, than by manufacturing it himself and selling it afterwards.

1408. A proprietor having saw-mills upon his estate should let them to such timber merchants as purchase the round timber from him, at a certain annual rent. This is our own mode of going to work, and we find it the most advantageous to our employer.

1409. It is often of advantage to a proprietor that he have a small saw-mill for manufacturing such timber as he may require for estate purposes; but as this is not understood to be kept for manufacturing for sale, but merely for home convenience, the result is more likely to be beneficial than otherwise, when under the superintendence of a judicious forester.

1410. But even although the result in regard to the manufacturing of timber were to be generally otherwise to the proprietor than has been stated, I would distinctly say that where an open sale is at all times kept by a proprietor of woods, it is almost impossible for him to have his plantations reared on a right and profitable principle. When an order comes in for a certain class of wood, the foresters are sent out to procure it from a certain plantation, from which it is taken without due regard to the welfare of the crop; and it therefore follows that the crop of all the plantations so dealt with is injured to a large extent, and never afterwards comes to such an ultimate value as it would have done had it not been interfered with to supply orders. I have seen this so often done, that I here raise my voice against such a mode of dealing with plantations. I have seen, where saw-mills were kept by the proprietor for the manufacture of timber on his own account, the foresters sent out to cut trees of a certain size, from a plantation that had been thinned only one year previously, which could not be properly spared from the crop, and which ought, therefore, to have stood for other two or three years, but were wanted to complete an order. This certainly was the worst possible management; still it is adopted to a large extent where saw-mills are kept by proprietors, and is one of the causes of the wretched state in which we find the woods on many properties.

1411. I shall conclude this section by remarking, that few proprietors who keep saw-mill establishments on their estates are aware of the damage that is done to their plantations by their foresters taking in orders, and supplying them from such of the woods as will produce the class of trees wanted at the time. The orders are generally undertaken without much previous consideration on the part of the forester as to whether the trees are to be had without doing damage to the plantations or not; and, once undertaken, the order must be executed, and for this the trees must be cut from some one or other of the plantations, whether they can be judiciously spared or not. And the result generally is, that the plantations are searched all over for certain trees, the removal of which is generally a greater loss to the proprietor than can be made good by any value got for them at the time.

SECTION IV.—THE PREPARING OF TIMBER FOR BETTER PRESERVATION.

1412. Timber of well-matured growth, if sawn up immediately when felled, and properly seasoned and preserved from wet afterwards, will last good for a great number of years; or, if it be kept constantly saturated with water, it will last fully as long as when kept perfectly dry, and perhaps much longer. The best timber, however, if exposed to alternate changes of wetness and dryness, will last but a comparatively short time, as in the case of posts for fences, railway sleepers, &c. &c. It has, therefore, become a matter of very considerable importance to railway companies, miners, and others who use wood to a large extent, to adopt some process of preparing their timber before they use it; and on this subject many experiments have been tried, and many ingredients used, some with considerable, and others with little effect. As this is a subject on which there is yet a great want of correct information, and on which there is a great variety of opinion as to results of experiments, even among those who have used the same preparation for preserving their timber, I shall confine my remarks on it chiefly to our own experience, and to reliable information received from respectable parties.

1413. I have invariably found that timber, of all kinds and ages, will rot much sooner if used with the natural sap in it, than it will if seasoned, although it should afterwards be saturated with water and subjected to alternate wetness and dryness; this proving, that the natural sap of any tree is a more rapid decomposer of its own timber, after its vitality has ceased to act, than common water is, and that a very considerable advantage is to be gained in this respect by drying all timber before using it, for whatever purpose.

1414. I have, in an especial manner, to call the attention of railway companies, miners, and estate agents, to this fact, that all sorts of timber, *having its natural sap expelled, will last afterwards, although subjected to wetness,* at least one-fourth longer than if used with the natural sap in it. This is a fact that does not seem to be understood by parties generally who use wood for outdoor and pit purposes; if it was recognised by them, I do not think they would allow their sleepers and props to be used so soon after they are cut from the trees as we generally find them, and this, of course, very much to their own disadvantage and loss.

1415. The principle of preserving timber from the effects of alternate wetness and dryness is, therefore, to expel the natural sap, and afterwards to fill, as far as practicable, the open vessels of the woody fibre with some substance known to have the effect of preserving the tissues from natural decomposition; and of course, this filling up of the vessels of the wood can only be effected by their absorbing the substance to be used in the state of solution in water, or by its being forced into them by pressure. One advantage to be gained from the adoption of such a mode is, that the younger the timber, the more open is the fibre of the wood, and therefore the greater the quantity of the substance in solution which will be conveyed into the vessels; so that if the substance used be found at all to preserve the timber to which it is applied, it will have the greatest effect on young and soft grown timber.

1416. We know that lime is a preserver of timber, when that substance is absorbed into the vessels. The way this is done is to take *slaked lime,* or *hydrate of lime,* and mix it with water in a tank till the solution is quite thin and of a watery consistency. Into this tank the timber should be put, after having been properly seasoned, and sawn up for the purposes for which it may be wanted. It should be allowed to lie in the solution for a number of days, in proportion to the scantling to which the timber is cut. If the scantling is small, such as boards, it may have absorbed enough in four days after being put into the tank; but if somewhat large, it may require ten days, and if large, even fourteen days may not be too much.

1417. As soon as the timber has been long enough to allow of sufficient absorption, it should be taken out, and afterwards so thoroughly dried as to expel all the water from it, when it can be applied to use. I have seen timber treated in this way last upwards of fifteen years as a fence; and when I saw it it seemed very little decayed indeed, and then likely to last other four or five years at least.

1418. Common salt is also a preserver of timber. For this purpose it is dissolved in water in a tank, into which the timber is put to steep, in the same way as described in reference to the lime solution; with this difference, that as the salt held in the water enters the vessels of the wood much sooner than the lime does, they will be generally found filled with the salt solution in about half the time specified for the other solution.

1419. That salt is a preserver of timber has long been experienced by the timber merchants who live at Garemouth, on the sea-side, at the mouth of the Spey. To this place large quantities of timber are floated down the Spey from Strathspey; and it has long been remarked by the inhabitants of Garemouth, that the timber which lies longest among the salt sea-water, after it is floated down, is that which is most likely to last long for any purpose afterwards.

1420. For the better preservation of the timber which we use ourselves in many of the works with which we have to do, we use a recipe which I got from, and which for many years has been used by, a landed proprietor with whom I am acquainted, and which he has found to answer well in the preservation of such timber as he uses for fencing purposes. The recipe is this:—

> The ingredients used, and their proportions are—
>
> 1 lb. sulphate of copper.
> 1 lb. sulphuric acid.
> Six gallons of water.
>
> *Directions for mixing for use:*—Dissolve the sulphate of copper in 1 gallon of boiling water, then add 5 gallons of cold water; mix well, and then add the sulphuric acid—common strong oil of vitriol.

Following these proportions, any quantity of the mixture may be made. In using it, the tank should be filled to about one-third of its depth, when the timber to be steeped for preservation should be laid in it in a regular manner.

1421. The timber should be well seasoned before it is put into the tank. Twenty-four hours is sufficient for the steeping of timber of small scantling, and large scantling in proportion. By steeping timber in this mixture, it will last nearly double the time it usually does when used without such steeping.

1422. I might refer to several other recipes used for the same purpose; but as the above are the only ones I have personally tested by experience, I prefer not to advert to any I do not know sufficiently to justify my recommending them.

SECTION V.—WEIGHT OF DIFFERENT KINDS OF TIMBER, BOTH IN THE ROUGH AND MANUFACTURED STATE.

1423. The comparative weight of the different sorts of timber is a branch of forestry which has hitherto received too little attention from those engaged in it, and from this cause many miscalculations have been made by foresters in reference to the carriage of wood, as well as in reference to the quantity of manufactured timber that a certain number of trees, of a given size, should turn out. There are few men engaged in forestry at the present day, who could calculate the probable weight of a given quantity of timber, of a given age, and of a given sort, whether in the rough or manufactured state, or what quantity of deals, scantlings, &c., should be produced from a given number of feet of timber.

1424. We are now, however, put in possession of such an amount of knowledge on this subject, as will prove highly instructive and useful to all interested in the subject, both foresters and timber merchants; and for this we are indebted to Mr Rait, the very intelligent and persevering forester at Castle Forbes, in Aberdeenshire, who has devoted many years of labour and study to experiments on the subject of this section, and who, I believe, intends to publish a work on it and the relative value of timber, ere long, and as soon as he shall have his experiments completed and in readiness.

1425. The tabular statements which follow in this section have been sent me by Mr Rait for publication in this work, and it is to him, therefore, that their merit is due. I shall, in what follows of this section, give these statements as they were received from that gentleman, and make my remarks upon them, in explanation of the different points they embrace; and as some of those points are very important, both for the practical forester and the timber merchant, I shall refer to them at some length. The following is the first of these tables, which, however, Mr Rait informs me, is only a first draught, and the arrangement of which is yet to be slightly modified:—

[illegible]

	Weight per [illegible]	Weight per Cubic [illegible]		Number of Cubic Feet to a Ton.	
		Seasoned.			
	Green.	[illegible]	Dry.	Green.	Dry.
	[illegible]	lbs.	lb.		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	34[illegible]	35[illegible]	64[illegible]
	[illegible]	[illegible]	28	36[illegible]	80
	[illegible]	[illegible]	29¼	35½	76½
[illegible]	[illegible]	[illegible]	...	...	...
[illegible]	[illegible]	[illegible]	...	...	...
[illegible]	[illegible]	[illegible]	...	...	...
	45¾	[illegible]	32½	46⅔	69
[illegible]	[illegible]	34[illegible]	...	...	...
[illegible]	[illegible]	28[illegible]	...	...	...

[illegible] AND WEIGHT.

[illegible] Feet [illegible] a Ton.	lb.	lbs.	lb.	Cubic Feet to a Ton.	Cubic Feet to a Ton.
[illegible]	35½-54	27⅓-363	26-34⅝	35½-36⅝	64⅛-86⅛
[illegible]	49-58¼	28-33	29¼	35½	76½
[illegible]	35½-46⅛	28¼-38	32½	46⅔	69

[illegible] the length. This rule has would approach each other.

1430. Having given this tabular statement, I shall now make some remarks in explanation of it; and in the first place I may observe, that the table is divided into two great heads—viz., 1st, the weight of spruce fir, Scots pine, and larch timber, per cubic foot, and the number of cubic feet to a ton weight of each sort, in the rough or unmanufactured state; and 2d, the weight per cubic foot, and the number of feet to a ton weight, both in the green and dry states, of the same sorts of wood, but manufactured.

1431. Beginning at the left-hand side of the top of the table, and reading the headings of the different columns, it is observed that the weights of the different kinds of timber experimented with are given both with the bark on and with it off. This is a great advantage, as in the carriage of such unmanufactured timber, it is always desirable to know the weight of it both ways.

1432. Passing the headings in reference to the unmanufactured timbers, the eye next glances over the different columns in reference to the weight of timber in the manufactured state; and here we find that this is given both in the green and dry state, per cubic foot, and the number of cubic feet to a ton, both in the green and dry state. These details are given in regard to boards and scantlings, as well as to the heartwood and sapwood of each sort respectively.

1433. It will be interesting to compare some of the results of the experiments as brought out in paragraph 1426, in reference to the weight of the spruce fir. Here, in the first column, it is shown that the ages of the timber experimented on are from thirty-five years to ninety years, while, from the third column, it is brought out that the timber of the spruce fir, with the bark off, is, as nearly as possible, of the same weight ($69\frac{7}{8}$ lb. per cubic foot) from thirty-five to fifty years of age; but that when it is so old as ninety years, it becomes as light as 57 lb. per cubic foot. This of itself is a fact worth much to those who deal in such timber, as it is at once an evidence that the older this wood is the lighter it becomes, and therefore can be the more cheaply carted.

1434. Passing on to the seventh column, we remark that the number of cubic feet to a ton of the spruce fir timber, without the bark, is as nearly as possible the same at thirty-five and at fifty years, being $32\frac{1}{16}$ and 32 respectively; while, when the timber arrives at ninety years of age, it is shown that it requires $39\frac{1}{3}$ cubic feet to make a ton weight.

1435. Let us for one moment compare the weight of the heart and sap wood of the spruce fir. Passing along to the right-hand side of the table, we observe that one cubic foot of the heartwood of spruce fir, in the dry state, and at thirty-five years of age, weighs $26\frac{3}{4}$ lb.; while, at fifty years of age, it varies from $24\frac{11}{32}$ to $28\frac{23}{32}$ lb.; and that, at ninety years of age, it generally weighs 28⅛ lb. On the other hand, one cubic foot of the sapwood, in the dry state, and at thirty-five years of age, weighs 28 lb.; at fifty years, from 26 to 27 lb.; while at ninety years it weighs 34⅞ lb.: thus showing, that at all stages of the growth of the tree the sapwood is considerably heavier than the heartwood.

1436. The results noted under paragraph 1427, in reference to the weight of Scots pine timber, are given on timber of sixty and of one hundred years of age; and as the figures speak for themselves, I need not lengthen my remarks on them, as the reader can examine them, and note comparisons himself,—the remarks just made in reference to the spruce fir serving him in some degree as a guidance in such comparison.

1437. The experiments noted under paragraph 1428, in regard to the weight of the timber of the larch, are of a more limited character than those of either of the other two kinds, they being confined to trees of sixty years of age. Still, so far as they go, they are highly useful. They show that the weight of a cubic foot of larch timber, in the round state, and from a tree of sixty years of age, and with the bark off, varies from 61 to 69 lb., and that from 32½ to 36⅔ feet are required to make a ton weight.

1438. In examining the results brought out in this table, the RANGE OF AGE AND WEIGHT, as given under paragraph 1429, will be found very useful for a comparative glance of the whole. I shall next give a table in reference to the weights of the commoner sorts of hardwooded trees. It is as follows:—

TABLE

Table showing the Weight of Oak, Ash, Elm, Beech, Birch, Plane, and Horse Chestnut, in the Round and Manufactured, Green and Dry States.

	In the Round or Unmanufactured State.						No. of cubic feet to a ton.	In the Manufactured State.					
	Species of Tree.	Years planted.		Girth in inches.	Comparative weight in pounds of a piece with and without bark.	Weight per cubic foot in pounds.		Where cut from.	Dimensions of sections.	Weight per cubic foot.		Cubic feet to a ton.	
										Green.	Dry.	Green.	Dry.
									ft. in. in.	lb.	lb.		
1439.	Oak, ...	100	Bark on	32⅛	35	90	24 8/9	Heart of Log	1 3 × 2	69	53¼	32½	42
			Bark off	30	31⅛	81	27⅝	Sapwood	1 3 × ¾	62¼	41	36	54⅝
1440.	Oak, ...	52	Bark on	27	24 23/32	93 9/17	24	Heart of Log	1 3 × 2	73⅞	50⅜	30⅓	44½
			Bark off	24¾	22⅛	83¼	26 11/12	Outside	1 3 × 2	67⅛	48	33⅓	46⅔
1441.	Ash, ...	52	Bark on	38¼	41 1/16	73	30 5/7	Heart of Log	1 3 × 2	51¾	42	43¼	53⅓
			Bark off	36	36⅞	65½	34⅕	Outside	1 3 × 2	53¼	42⅝	42	52 4/7
1442.	Elm, ...	70	Bark on	27¼	21⅛	76	29½	Heart of Log	1 3 × 2	53⅝	37½	41¾	59¾
			Bark off	25¼	18¼	65½	34⅕	Outside	1 3 × 2	54¾	38⅝	41	58
1443.	Beech, ...	70	Bark on	36	44 7/16	84 3/16	26⅗	Heart of Log	1 3 × 2	63⅜	46½	35⅓	48⅙
			Bark off	35	42 5/16	80⅛	28	Outside	1 3 × 2	64⅛	45¾	34⅞	49
1444.	Birch, ...	70	Bark on	38⅛	43⅛	82¾	27	Heart of Log	1 3 × 2	58½	40½	38¼	55⅓
			Bark off	34¾	37 5/16	71⅝	31¼	Outside	1 3 × 2	57⅞	42	39	53⅓
1445.	Sycamore, . .	52	Bark on	39¾	52 5/16	87 9/16	25 4/7	Heart of Log	1 3 × 2	62¼	43½	36	51½
			Bark off	37¼	47	78 11/16	28 3/7	Outside	1 3 × 2	63¾	46⅛	35 1/7	48 4/7
1446.	Horse Chestnut,	52	Bark on	38½	40 9/16	69 17/32	32⅕	Heart of Log	1 3 × 2	52⅛	32¼	43	69½
			Bark off	36½	35 13/16	61⅝	36⅓	Outside	1 3 × 2	53¼	33	42	67⅞

1447. Having said so much in explanation of the tabular statement in reference to the weight of the fir, pine, and larch, it is not necessary that I should make any lengthened remarks in explanation of the one just given in regard to the hardwooded sorts of timber, as its figures speak clearly for themselves in the way that they are arranged; and the reader can see at once what is represented by the different columns, from the headings written on them.

1448. With special reference to the experiments set forth in the table just given, I may point out their advantages to all engaged in manufacturing timber. For example, opposite to paragraph 1439 it is shown in the fifth column from the left side, that, generally speaking, if a piece of oak of 100 years growth weighs 35 lb. with the bark on, it will weigh only 31½ lb. after the bark is taken off it. In the sixth column it is next shown, that one cubic foot of oak, of the age stated, weighs 90 lb. with the bark on, and only 81 lb. with it off: thus showing the weight of bark that may be expected from such timber, per cubic foot, in the green state.

1449. We shall now compare the weight of a ton of this class of timber, as it is shown from these experiments, both in the round and in the manufactured states, and in the green and dry states also. It is stated in the seventh column, and opposite to oak of 100 years, that, with the bark off, 27⅝ feet make one ton (this is of course in the green state). From this, then, it is shown that a timber merchant, in removing such timber, could only take about this number of feet on one horse as a load: thus proving the great advantages resulting from the manufacture of timber on the spot, as it is further shown, in the twelfth column of the paragraph referred to, that after the same timber is manufactured, and although in the green state, no less than from 32½ to 36 feet of it can be taken on a horse, as one ton weight: thus making a difference of 7 feet to the ton, on the average, in favour of the manufactured timber. But a still greater difference is obtained by having the timber properly seasoned before it is removed to a distance. This is shown in the two last columns in reference to the oak of 100 years; for in them it is stated, that although from 32½ to 36 feet of the manufactured timber may be taken as a load, of one ton weight, while the wood is in the green state, when it has been dried, no less than from 42 to 54⅝ feet can be taken. These are facts worthy the notice of all interested in the cutting down and manufacture of timber, and I therefore recommend my readers to study well, in these respects, the bearing and results of both the foregoing tables, in reference to the results they represent on all the kinds of timber detailed in them, whether pine, fir, larch, oak, or other hardwoods.

1450. Having made the foregoing remarks on the character and tendency of the information contained in these tables, I need not add more in regard to them, but state my hope that foresters generally will set about making similar experiments for themselves, as to the weight of the different kinds of timber per foot, and the number of feet required to make up a ton, both in the round and in the manufactured states, &c., in the different parts of the country.

1451. In making such experiments, however, it would be well to improve on the subject of these tables, as, however good they may be at the present stage of our information on the subject, much useful information might be added in taking up and studying the subject systematically. For example, in making experiments in regard to the weight of the timber of any particular kind of tree, it would be an improvement to state the character of the land on which it grew, its aspect, whether a hill side or a flat, the elevation above the sea, whether the land had been drained, or was naturally dry, the exact age of the tree on which the experiment was made, its dimensions, and whether it grew in a crowded plantation, &c. &c.

1452. I have reason to know, from my own observations on this subject, that the weight of any given kind of timber is much influenced by the nature of the land on which it grows, by the aspect of the situation, as well as by the absence or presence of much direct sunlight on the stems and branches, and also by the coldness of the subsoil from wetness. To make complete and satisfactory experiments on this very interesting branch of forestry, therefore, all these points should be kept in view by the experimenter; and, if possible, the experiments should be made on each kind of timber, at all ages, from ten years old up to one hundred years.

CHAPTER XIII.

SECTION I.—REPORTING ON WOODLANDS.

1453. It seems to me that the reporting on the condition, and as to the best mode of dealing with the plantations upon estates, by some one known to be well skilled in the management of woodlands, is too little attended to by their proprietors; as, if it were otherwise, and judicious instructions properly carried out, we should not find the greater part of the woodlands of Britain in the unprofitable and neglected state in which they are.

1454. Not long since, during a journey from Inverness to one of the southern counties of England, along the whole line by which I travelled, I did not see more than five properties on which the plantations had been properly attended to, and on which the woodland crops gave evidence, from their superior condition, that they were to result in a high value to their proprietors. On learning the names of these latter estates, I had afterwards no difficulty in finding out the names of the foresters under whose management the plantations had been reared; and I found, as I had anticipated, that they were all men who stood high in their profession, and who were in possession of no ordinary degree of intelligence in all the branches of science bearing upon it. I learned also that these woodlands were all in the possession of extensive proprietors, whose extent of plantations had enabled them to pay for superior men to conduct them; which goes to prove, that unless a proprietor will make up his mind to pay for a good man to manage his woods, he must be content to have them mismanaged; and this remark, generally speaking, holds good in all departments of business, as well as in that of forestry.

1455. During this journey I saw the plantations on some estates in the worst possible condition, and on inquiry as to whom they belonged, I almost invariably found that they were in the hands of comparatively small proprietors, who kept mere woodmen to look after them, who could fell trees when required, or measure them for sale, but who knew no more of forestry, properly speaking, than the merest labourer in their neighbourhoods. Could any other result be expected from such men than that the plantations over which they looked—for they merely looked over them—should be in the worst possible state? Can any proprietor expect that a man who is content to work in his woods for £40 a-year, should be as good a forester, and as profitable a one, as one that would not serve him under three times that amount?

1456. In forestry, as well as in all other branches of business, men are paid according to their ability; and it is in large establishments that we find men of large abilities. This statement is applicable generally, for there are sometimes exceptions; but in the common nature of things this will be found to hold good, and especially in regard to forestry, and the sister branches of rural economy.

1457. At this stage of my remarks on the subject, the question very naturally arises, How, then, should small proprietors conduct themselves in regard to their foresters, since the extent of their woodlands will not admit of them employing men at a salary beyond what the income from their plantations will justify, in the general management of their properties? My reply is, A skilful man is always a more profitable one, in any business whatever, than one of an opposite character, all circumstances alike.

1458. In illustration of this I may remark, that if a landed proprietor has 500 acres of woods, he would, without doubt, realise a greater annual income from them by putting them into the hands of a man as forester at £100 a-year, than he possibly could were they in the hands of one at £50; inasmuch as the man at £100 of salary would, or at least ought to be able to bring a greater degree of intelligence to bear upon all his operations than the other.

1459. On this point all the difference lies betwixt the profitable and unprofitable management of anything. In the very mode of going about the labour of woods, an intelligent forester will save a large percentage of expenditure compared with one who is not so, independent of the fact that the one is also able to make better and more profitable sales of the produce than the other; thus enabling his employer to pay him a higher salary than he could to the other.

1460. I have seen this exemplified in so many cases during my experience in the last ten years, that I strongly urge every proprietor of woods either to secure the services of an intelligent forester, or keep none at all, in the common sense of the word, but a mere labouring woodman, to act under the directions of another.

1461. I could give many examples in illustration of the reasonableness of this recommendation; but I shall content myself with one. A short time ago I was called out to inspect the plantations upon an estate, and asked to give my report on them for the future guidance of the forester. The plantations in all extended to about 350 acres, and were of ages varying from fifteen to fifty years; with groups of hardwoods of greater age, in the neighbourhood of the mansion-house. From the death of the proprietor, the heir of the estate had been in minority for some ten years, and during all that time little or no thinning had been performed for the welfare of the plantations, either in the younger or older ones; so that, as a whole, I found them in a very unsatisfactory state indeed; generally, the crops—except on some partial spots where trees of some size had been cut for estate purposes—were drawn up and weakly.

1462. In my survey of the plantations, I was accompanied by the man called the forester, who had been, and was, a mere feller of trees when wanted for estate purposes, and who indeed knew the one sort of tree from the other, but had no definite idea of the advantages of thinning, or of draining, to the health of the trees that had been nearly twenty years under his care; and the result of this was, the unsatisfactory state in which we found the several plantations. I learned from him that the late proprietor had taken the principal charge of the woods himself, for the purposes of recreation and amusement; that he marked himself the trees that were to be removed as thinnings, and that the forester had only to fell such as he marked. There was, indeed, evidence of this on the condition of the several crops, as they seemed to have been pretty well thinned at one time.

1463. Here, now, was a case of mismanagement in plantations, from the want of intelligence in the man placed over them as forester; and one that clearly shows the great loss that proprietors, in a great number of cases, sustain by leaving their plantations in the hands of unqualified men. But more specifically, here was a case in which I found the plantations which, had they been properly attended to, at their age ought to have had a crop worth on the average some £40 per acre, not worth the half of this, and which, prospectively, had been rendered of comparatively small value.

1464. What I wish to infer from the foregoing is, that it would have been vastly more advantageous for this property, had those in whose charge it was left paid several hundred pounds to a well-qualified forester per year, than to have left the woods in the hands of the man they allowed to remain in charge of them, and from whose simple ignorance the plantations had been comparatively ruined.

1465. As I found the forester then resident on the estate incapable of carrying out my recommendations for the improvement of the plantations, and saw that the income likely to be derived from them would not, at least for a number of years, well allow of a first-rate man being constantly employed in them, I recommended that an expert woodman should be engaged to superintend the labourers engaged in the different works of thinning and draining as they fell to be performed, and that an experienced and highly-qualified man should be called in to mark the trees to be removed as thinnings, and to attend to lay off drains, and give general specifications and instructions, consistently with my report on the subjects, from time to time, as the different works required attention.

This mode of procedure was at once adopted, and I am told that it works most advantageously, under the superintendence of the qualified forester, who visits the estate some four times a-year, and each time examines the works that have been performed since his last visit, as well as lays off new works for the next quarter.

1466. This case explains the meaning of the statement made in paragraph 1460, that "I urge every proprietor of woods either to secure the services of an intelligent forester, or not keep one at all." I have recommended the same mode of procedure—with a common woodman, headed by an intelligent forester from time to time, to whom he referred in all cases of seeming difficulty—in regard to the woods on many small properties I have visited, and where the proprietors were not so much interested them-in the management of their woods as to induce them to see the points of my report carried out; and in all cases it has given the most entire satisfaction.

1467. By adopting this mode of managing the woods on small properties, on which a highly-qualified man could not be constantly maintained, the woodman, who is of course a mere workman over others, if necessary, is in no way trusted with the management of the woods, but only works under the directions of the qualified man, to whom from time to time he looks for guidance, and whose check for badly performed work, or approval for well performed, keeps him at all times at his duty, in order to see that matters are in proper order for inspection when his superior calls upon him.

1468. Having made these preliminary remarks on the subject of the management of woods on those small properties where a properly qualified forester cannot well be profitably maintained, I proceed to describe how the reporting on woodlands should be dealt with generally, for the guidance both of the proprietors themselves and of the persons in charge of their woodlands. I might have entered on this at once, without any of these preliminary remarks; but I thought it better to refer, in the first place, to the bad state in which plantations on small properties are generally found, in order to bring out more clearly the great necessity there is for every proprietor being furnished with a report on the management of his woods, by some intelligent and skilful man in his profession; as, without such a report, the works of thinning, draining, &c. &c., can never be carried out systematically, nor the income realised, with that degree of profit or satisfaction which the proprietor has a right to demand of the person into whose hands he gives the charge of his woods.

1469. In the management of woods, as well as in that of any other branch of business, unless a definite and suitable class of rules and regulations be laid down, adapted to meet the nature of the subjects, the whole business gets into disorder; transactions, whether in regard to income or expenditure, result unsatisfactorily, and from this the business becomes unprofitable to its proprietor. To obviate such results in regard to the management of woodlands, is the object of judiciously reporting on them.

1470. In reporting on the woodlands of any estate, the following SEVENTEEN HEADS should be laid down by the reporter as a ground-work for his subject:—

1st, A tabular statement showing the extent of the woodlands on the property.
2d, The present condition of the crop in each separate plantation.
3d, The nature of the past management under which the plantations have existed.
4th, How far the several crops had been properly suited to the different descriptions of land planted.
5th, The plantations which have made most progress at their respective ages, and the circumstances which have contributed to this state of the trees.
6th, Those which are unhealthy or diseased, and the cause of this.
7th, The particular system of forestry that should be adopted for the improvement of the plantations generally.
8th, General recommendations and specifications in regard to fencing.
9th, The same in regard to the operations of drainage.
10th, The same in regard to the replanting of unoccupied spots in the existing plantations.
11th, The same in regard to the planting of new enclosures.
12th, The same in regard to the mode of pruning suitable for the several crops.
13th, The same in regard to the operations of thinning.
14th, The income which, under good management, may be annually derived from the plantations.
15th, The expenditure which, in all probability, will be annually required to carry out the improvements suggested, and to maintain the woodlands in proper condition.
16th, How wood sales ought to be conducted on the property, taking the situation of the plantations, and their distance from market, into consideration.
17th, Statement showing the probable income that may be derived from each plantation during the next ten years.

1471. Having given the foregoing seventeen heads as the points which should be specially attended to by any one who would undertake reporting on plantations, whether of a small or large extent, I shall next devote one paragraph to a short description of the manner in which the reporter should take up and illustrate each of them, for the full benefit of the proprietor and his forester.

1472. In taking up the subject of the 1st heading, the reporter should be careful to make his tabular statement as comprehensive as possible, and he should at least embrace in it the following points, each of which should be stated under a separate column: viz.—the name of each plantation; the nature of the under-lying rock; the character of the soil and subsoil; the condition of the land previous to its having been planted; the extent in imperial acres; the character of the crop; its age; description of fence by which surrounded; and elevation above the sea.

A well arranged statement of this sort will form a history of each plantation, and will be found of great use both to the reporter himself, while he is engaged in the work of reporting, and to the proprietor and his forester afterwards.

1473. With regard to the 2d head, the reporter should prepare himself, by a careful examination, to give a particular account of the state in which he finds the crop in each plantation, attending particularly to note the state of the trees, as he finds them affected by crowdedness or thinness, and by wetness or dryness, &c. &c. He should also note the state of the fences on each separate enclosure, the extent of drainage necessary to improve the crop, and the probable value of the crop of each, both at present and prospectively.

1474. As to the 3d head, he must be careful, as he proceeds, to note in reference to the health of the several crops, and state whether the trees are suited to the land they occupy, and whether they are likely to arrive at much value upon it.

1475. The subject of the 4th head can, of course, be drawn from the general tone of the notes taken in reference to the plantations respectively.

1476. With reference to the 5th head, the reporter should also prepare himself for drawing it out by taking judicious notes in respect to the crop in any particular plantation, or in reference to that on any part of one which seems particularly good of the age, so as to illustrate facts in reference to his general recommendations for the improvement of the whole; and he should be careful to show the cause of such trees being so much better than others of the same age, &c.

1477. In reference to the 6th head, I need only remark that the reporter should be as careful to show the cause of disease in one crop or part of one, as he is to show the cause of the opposite state, as the illustration of both heads is equally necessary for the guidance of the proprietor and his forester.

1478. Although all the headings set forth for description in the 1470th paragraph are absolutely necessary to make up a proper and useful report on woods, still it may be safely stated that the 7th subject is the most important, and should therefore be illustrated in the most minute, careful, and intelligible manner, as upon the proper laying down of suitable rules for the after guidance of the forester in all the different branches of the work, the advantages derivable from such a report depends. This subject should, therefore, be carefully taken up and discussed, and a right system of forestry laid down for the guidance of the proprietor who employs him.

1479. I need make no comment on the subject of the 8th head, as it is short and clear of itself, and should be taken up and proper recommendations given according to the nature of the country.

1480. The 9th head is a very important one also, and should be carefully attended to by the reporter, especially in reference to depth and distance apart of the drains, according to the nature of the land. He should also note the probable expense of the drains to be made in each separate enclosure, and the extent necessary to have operated on in each case, and he should draw up a statement showing the particulars of all drainage operations he purposes for the improvement of the crop of each enclosure.

1481. A tabular statement should be drawn up in reference to the subject of the 10th head, showing the extent to be replanted in each separate plantation, the kinds of plants to be used, and the expense of the operation; and any explanation may be given by the reporter on the results brought out in such a statement, as may seem most necessary for the cases.

1482. The 11th head has reference to the planting of new enclosures; and as this is a most important point, every particular in regard to the proper performance of the work should be clearly and intelligibly laid down, so that no two opinions may arise on any point afterwards. After detailing as to fencing and draining, the reporter should show the parts, *by a plan*, on which to plant the several sorts of trees, and should state the distance apart of the young plants to be used, &c. &c.

1483. The 12th head has reference to the particular mode of pruning which should be adopted for the improvement of young hardwooded trees; regarding this, I may only state, that a judicious reporter, who understands his subject, will be very guarded as to how far he recommends this operation as an improvement in respect to young trees, as there is, generally speaking, more harm done by pruning than advantage gained by it: still the subject should be referred to.

1484. The 13th head is also a very important one, and should on that account be minutely gone into. The reporter should give a specimen of his mode of thinning in each plantation he recommends to be thus operated on, and to these specimens he should refer under this head. He should, at the same time, give specifications as to the general mode and expense of the operation in reference to the crop in each separate plantation, as well as any other particulars that occur to him on the subject.

1485. As the subject of the 14th head is, as it were, the harvest of all the operations, the greatest care should be taken to show the quantities of wood, bark, &c., that may be taken from each wood to be operated on, in a given year, and its value according to the present prices. A proper tabular statement should be drawn up, showing the probable amount of income from each of the woods to be operated on for the year, and his grounds for arriving at such conclusions in respect to this. He should, of course, carry his statement as to income over a given number of years, and afterwards the proprietor will be able to ascertain, from after results, how far the reporter formed a correct statement.

1486. The 15th head is also an important one, and should be very correctly gone about in making calculations in regard to it. Every item of expense should be noted, under its own proper head: for particulars, see statement in next section, in reference to explanation.

1487. Heading 16th is a subject of very great importance to attend to in reporting on woodlands, and should therefore be judiciously gone into. This subject should be taken up at such a length, as to explain every particular necessary to show how the present prices of wood are affected, by roads and distance from market, and how higher prices might be realised, by adopting certain improvements in sales and the mode of transit.

1488. The 17th head should be in the form of a tabular statement, setting forth the points referred to; and as the making up of such a statement requires great judgment and experience to do it correctly, none should attempt it who has not full confidence in his own experience, as errors in this respect will soon appear against the reporter.

SECTION II.—SYSTEM OF BOOK-KEEPING ADAPTED TO FOREST OPERATIONS.

1489. To be able to keep correct and satisfactory accounts of all transactions, whether in respect to income or expenditure, is a great recommendation to the person who professes to manage any business; and this holds good in regard to a person who manages woods, as well as in any other profession. A forester who is not able to keep correct account-books, in reference to all the transactions that may pass under his hands, is not fit to fill a situation of any importance; and, in fact, must be considered as a mere woodman or wood labourer.

1490. I am aware that there are comparatively few foresters who are good accountants, and who can show to their employers, at any time they may wish it, the real state of income or expenditure on any given branch of the charge under them. Knowing, therefore, that foresters would be much benefited by having a system of book-keeping specially adapted to their use, and such a system as may be considered simple and comprehensive, I propose, in what follows of this section, to draw up such a system specially for their use, which I think will be found so simple as to be easily understood by any one of ordinary intelligence.

1491. The very first account which a forester should make out on entering on the duties of a new year (at whatever time of the year this may be; and this of course will always depend on the time that the proprietor makes up his yearly accounts), is an ESTIMATE setting forth the particulars of income and expenditure for the year to follow; without such an estimate, to guide both the forester himself and his employer, both would be, in regard to the works generally, similarly circumstanced to a mariner at sea without a chart. Such a statement is, in short, the groundwork of good management to a forester, in all his operations for the year afterwards, as well as highly satisfactory to the proprietor inasmuch as it enables him to understand, at the commencement of the year, what the forester intends to draw for him as income from his woods, as well as what he intends to expend on the various works proposed to be performed. The following statement will make this clear at once. After giving it, I shall make some remarks in explanation.

1492. ESTIMATE of the probable INCOME from, and EXPENDITURE on, the WOODS and PLANTATIONS on the ESTATE of LYNMORE, for the year from 30th April 1860 to 1st May 1861.

	Amount.	Total.	Remarks.
INCOME FROM SALES BY PUBLIC AUCTION.			
From sales of 10,000 larch trees, on the Hill of Bands, say at 10s. per tree,	£5000 0 0		This valuation is taken on the ground of the larch bringing 1s. per foot; Scots pine at 8d. per foot.
From sales of 12,000 Scots pine trees, in Plantation of Gorry, at 6s. per tree,	3600 0 0		
From sales of oak timber, from Adam's Wood, say 5000 feet, at 2s. 6d. per foot,	625 0 0		
		£9225 0 0	
INCOME FROM SALES BY PRIVATE CONTRACT.			
From sales of pine and larch thinnings from the Plantations of Burnside, Woodhead, Clury, Laggan, and Lait,	700 0 0		
From thinnings of oak from Rettie, Sluggan, and Eden Plantations, . .	400 0 0		
From thinnings of mixed hardwoods, from Damhead and Strawn Plantations, .	200 0 0		
		1300 0 0	
Carry forward, .		£10,525 0 0	

		Amount.	Total.	Remarks.
Brought forward,			£10,525 0 0	
From 50 tons of bark, from old oak timber, say at £5 per ton,		£250 0 0		
From bark from thinnings of young oak plantations, say 80 tons, at £8 per ton,		640 0 0		
			890 0 0	
INCOME FROM NURSERY STOCK TO GO OUT NEXT AUTUMN AND SPRING.				
40,000 oak, at 30s. per 1000,	£60 0 0			
16,000 ash, at 25s. ,,	20 0 0			
4,000 elm, at 25s. ,,	5 0 0			
200,000 larch, at 10s. ,,	100 0 0			
400,000 Scots pine, at 6s. ,,	120 0 0			
6,000 spruce fir, at 12s. ,,	3 12 0			
		308 12 0		
666,000				
10,000 thorns, at 15s. per 1000,		7 10 0		
			316 2 0	
From Rents of three Lodges,		18 0 0		
			18 0 0	
From Rents of three Saw-mills,		110 0 0		
			110 0 0	
Total probable income for the year,			£11,859 2 0	
EXPENDITURE.				
Salaries and Allowances:				
Forester,		£300 0 0		
Horse keep,		30 0 0		
Assistant,		100 0 0		
Horse keep,		30 0 0		
Woodmen in charge of enclosures, four at £40 each,		160 0 0		
Clerk to Forester,		60 0 0		
			£680 0 0	
Fencing:				
Braidwood Hill to enclose for planting, say 3500 yards of four-barred paling, at 8d. per yard		116 13 4		
Thortown Bridge to enclose for planting, say 4000 yards of stone wall, 5 feet high, at 2s. per yard,		400 0 0		
General repair of fences on enclosures;		150 0 0		
Repairs of gates on enclosures,		20 0 0		
			686 13 4	
Draining:				
Braidwood Hill, 30 acres of, say at £3 per acre,		90 0 0		
Thortown Bridge, 45 acres of, say at £3, 5s. per acre,		146 5 0		
			236 5 0	
Planting:				
Braidwood Hill and Thortown Bridge enclosures, 666,000 plants, as per statement under heading of income, *Nursery Stock to go out,*		308 12 0		
Expense of planting,		99 18 0		
60,000 pits for hardwoods, at 1s. per 100,		30 0 0		
Carriage of plants,		10 0 0		
			448 10 0	
Carry forward,			£2051 8 4	

	Amount.	Total.	Remarks.
Brought forward,		£2051 8 4	
Lodges:			
Repairs of, ...	£70 0 0		
		70 0 0	
Water Runs:			
Repairs of sides of, ...	110 0 0		
		110 0 0	
Saw-mill Dams:			
Repairs of, ...	30 0 0		
		30 0 0	
Roads, Rides, and Walks:			
New road from Saltown Bridge to Westergates, say 2300 yards, at 1s. 6d. per yard,	172 10 0		
Repairs of roads generally, ...	30 0 0		
Repairs of rides, ...	18 0 0		
Repairs of walks, and cleaning, . . .	40 0 0		
		260 10 0	
Hedging:			
On side of proposed new road betwixt Saltown Bridge and Westergates, preparing 1666 yards of bed for thorn plants, at 6d. per yard, .	41 13 0		
10,000 plants, at 15s. per 1000, . . .	7 10 0		
Planting, ...	2 10 0		
Carriage of plants, ...	0 5 0		
Cleaning of hedges generally, . . .	60 0 0		
Switching of hedges „	50 0 0		
		161 18 0	
Felling and Preparing Oak Timber for Sale:*			*In Adam's Wood.
Say 100 trees, at 2s. 6d. per tree, . . .	12 10 0		
		12 10 0	
Stripping and Curing Oak Bark:			
Say 130 tons, at £2, 10s. per ton, . . .	325 0 0		
		325 0 0	
Thinning:			
Pine and larch plantations, as named in estimate of income, ...	235 0 0		
Oak and mixed hardwood plantations, as named in estimate of income, . . .	60 0 0		
		295 0 0	
Clearing and Burning Rubbish:			
From cleared land, Heathfield enclosure, say	30 0 0		
		30 0 0	
Pruning:			
Young oak plantation at Rymore, say . .	8 0 0		
		8 0 0	
Nursery:			
Plants required for next year's stock—			
20,000 oak, 1-yr. seedling, at 4s. per 1000,	4 0 0		
10,000 ash, 2 „ 3s. 6d. „	1 15 0		
3,000 elm, 2 „ 5s. „	0 15 0		
150,000 larch, 1 „ 3s. „	22 10 0		
300,000 S. pine, 1 „ 1s. 6d. „	22 10 0		
2,000 silver fir, 2 „ 5s. „	0 10 0		
5,000 spruce fir, 2 „ 4s. „	1 0 0		
2,000 sycamore, 2 „ 7s. 6d. „	0 15 0		
500 lime tree, at 12s. 6d. per 100, . .	3 2 6		
500 new pines, of sorts, at 1s. each, .	25 0 0		
8,000 thorns, at 15s. per 1000, . . .	6 0 0		
501,000		87 17 6	
Carry forward,		£3442 3 10	

	Amount.	Total.	Remarks.
Brought forward,		£3442 3 10	
Nursery Labour :			
Laying 501,000 plants, at 1s. per 1000,	25 1 0		
Cleaning,	8 0 0		
Lifting,	6 0 0		
Digging,	7 0 0		
Manure,	5 0 0		
		51 1 0	
Travelling expenses of forester and assistant,	25 0 0		
Stationery,	8 0 0		
Criminal prosecutions,	35 0 0		
Carpenter work,	4 0 0		
Smithy work,	10 0 0		
Ironmongery,	8 0 0		
Keep of forest work-horse,	25 0 0		
Wages of carter,	30 0 0		
Repairs of harness (or saddlery),	3 0 0		
Advertisements of timber sales,	15 0 0		
Sale dinners,	10 0 0		
Printing catalogues and bills,	5 0 0		
Auctioneer charges,	10 0 0		
Rates and taxes,	80 0 0		
		268 0 0	
Total probable expenditure for the year,		£3761 4 10	

ABSTRACT.

Estimated income,	£11,859 2 0
Estimated expenditure,	3,761 4 10
Estimated net income,	£8,097 17 2

1493. The foregoing statement is an example of the way in which I myself, at the beginning of every year, make up an estimate of the income expected to be derived from the produce of our forests and plantations, and the expenditure to be laid out on them, a copy of which I register in a book kept specially for the purpose, and another I give to my employer, who, of course, has it in his power to object to any particular work proposed, or to approve of the whole, as may seem most desirable; and after being investigated and sanctioned by him, the works detailed pass into law for the season, and are afterwards set about by degrees, according to the season and nature of the work; it being always understood that the several works set forth are to be finished before the end of the year.

1494. Nothing can be more simple, to any intelligent forester, than the making up of such a statement at the beginning of every year, and yet how few are in the practice of adopting such a guide for their own and their employer's interest; for I maintain that when the forester does not attend to this, he is not fit for the charge he may have, however small it may be

—and that the proprietor who allows his forester to go on with sales and works, without first rendering to him such a statement, setting forth what he proposes, stands in the light of his own and his heir's interest.

1495. I have no doubt that to many foresters the making up of such an estimate may seem impracticable, and that these will do all in their power to persuade their employers that there is no necessity for such nicety of calculations. With regard to this, I may only add, that if the proprietor but intimate to his forester that he wishes decidedly to have such a statement, and that if he cannot do it he will get another who will, the forester will be compelled to lay his mind more to his duties, and afterwards prove both a better servant, and a more useful member of society. In short, no proprietor should keep a forester who cannot make up such an estimate in regard to his work as has been shown.

1496. Although the statement I have given embraces somewhat extensive sales of produce, as well as large works to be performed, still the model is equally applicable to estimates of all dimensions, whether in regard to estates on which there are only 300 acres of woods, or from 20,000 to 100,000 acres, or more; all the difference being that the sums will be large or small according to the extent of woods to be operated on.

1497. In drawing up such a statement, however, the forester should be most careful in making up his estimates, both in regard to the income and expenditure; as whatever sums he may enter against the different headings required to be detailed, if he be not correct in his estimates, the proof will undoubtedly tell against him at the end of the year, and from this his employer will at once learn whether he is qualified for his business, or the contrary.

1498. To avoid such an unpleasant state of things as has been hinted at above, in reference to incorrectness and incompetency in the forester, he should take ample time to calculate the value of the produce he intends to remove from any and every plantation he proposes to operate on for the year, and also that of the different works he sees necessary to have done, whether in regard to fencing, draining, planting, new roads, or repairs of old ones, hedging, thinning, &c. &c.; and if he should find himself at a loss to form a just estimate of the expense of any given work or works, he should take in estimates in regard to them from other parties. In short, in making up such a statement, he should enter in it every item of income or expense he anticipates for the year, and nothing should be left out; and this may be £100, or it may be £20,000, according to the character of the establishment.

1499. On the supposition, then, that such an estimate has been formed for the year, the next step in the system of book-keeping which I propose to lay before the reader, is the keeping of the Day-Labour Book. This is simply a detailed statement, in a tabular form, of what the workmen are employed at each day, with some other particulars, as will be clearly understood from the following specimen sheets from our own book, kept for the like purpose, and which embrace the particulars of the labourers' work for one month.

1500. STATEMENT of Workpeople employed in the Woods and Plan-

DAYS OF THE WEEK.	MONDAY.	Days.	Hours.	TUESDAY.	Days.	Hours.	WEDNESDAY.	Days.	Hours.
DAYS OF THE MONTH.	30.			1st May.			2.		
STATE OF THE WEATHER.									
THERMOMETER.									
A. M'Gregor,	Felling Oak Timber, Adam's Wood.	1	0	Felling Oak Timber, Adam's Wood.	1	0	Felling Oak Timber, Adam's Wood.	1	0
J. Grant, . .	... ...	1	0	... ...	1	0	... ...	1	0
D. Fraser, .	... ...	1	0	... ...	1	0	... ...	1	0
J. M'Donald,	... ...	1	0	... ...	1	0	... ...	1	0
W. Scott, . .	... ...	0	5	... ...	1	0	... ...	1	0
D. Ross, . .	... ...	0	5	Absent.	0	0	... ...	1	0
W. Calder, .	... ...	0	5	... ...	0	0	... ...	1	0
A. Robertson,	... ...	0	5	Felling Oak Timber,	1	0	... ...	1	0
J. Watson, .	... ...	1	0	... ...	1	0	... ...	1	0
J. M'Cook, .	... ...	1	0	... ...	1	0	... ...	0	5
H. Cameron, .	... ...	0	5	... ...	1	0	... ...	1	0
DAYS OF THE MONTH.	7.			8.			9.		
STATE OF THE WEATHER.									
THERMOMETER.									
A. M'Gregor,	Thinning Bankhead Oak Plantation.	1	0	Thinning Bankhead Oak Plantation.	1	0	Cleaning Hedges, North Park.	1	0
J. Grant, . .	... ...	1	0	... ...	1	0	... ...	1	0
J. M'Donald,	... ...	1	0	Absent.	0	0	... ...	1	0
W. Scott, . .	... ...	1	0	Thinning Bankhead Oak Plantation.	1	0	... ...	1	0
A. Robertson,	... ...	1	0	... ...	1	0	... ...	1	0
D. Ross, . .	... ...	1	0	... ...	1	0	... ...	1	0
W. Calder, .	... ...	1	0	... ...	1	0	... ...	1	0
J. Watson, .	... ...	1	0	... ...	1	0	... ...	1	0
H. Cameron, .	... ...	1	0	... ...	1	0	... ...	1	0
J. M'Cook, .	... ...	1	0	... ...	1	0	... ...	1	0
D. Fraser, .	... ...	1	0	... ...	1	0	... ...	1	0
T. Low, . .	Absent.	0	0	Absent.	0	0	... ...	1	0

ations on the Estate of Lynmore, from 30th April to 12th May 1860.

THURSDAY.	Days.	Hours.	FRIDAY.	Days.	Hours.	SATURDAY.	Days.	Hours.	Total No. of Days.	Rate per Day.	Amount.
3.			4.			5.					
										s. d.	£ s. d.
Felling Oak Timber, Adam's Wood.	1	0	Felling Oak Timber, Adam's Wood.	0	5	Thinning Bankhead Oak Plantation.	1	0	5.5	2 6	0 13 9
... ...	1	0	... ...	0	5	... ...	1	0	5.5	2 0	0 11 0
... ...	1	0	Absent.	0	0	... ...	1	0	5.0	...	0 10 0
... ...	1	0	... ...	0	0	... ...	1	0	5.0	...	0 10 0
... ...	1	0	... ...	0	0	... ...	1	0	4.5	...	0 9 0
... ...	1	0	... ...	0	0	... ...	1	0	3.5	...	0 7 0
... ...	1	0	... ...	0	0	... ...	1	0	3.5	...	0 7 0
... ...	1	0	... ...	0	0	... ...	1	0	4.5	...	0 9 0
... ...	1	0	... ...	0	0	... ...	1	0	5.0	...	0 10 0
... ...	1	0	... ...	0	0	... ...	1	0	4.5	...	0 9 0
... ...	0	5	... ...	0	0	... ...	1	0	4.0	...	0 8 0
											5 3 9
10.			11.			12.					
Repairing Fences on South District of Enclosure.	1	0	Repairing Fences on South District of Enclosure.	1	0	South District Enclosure, Scouring Drains.	1	0	6.0	2 6	0 15 0
... ...	1	0	... ...	1	0	... ...	0	5	5.5	2 0	0 11 0
... ...	1	0	... ...	1	0	... ...	0	5	4.5	...	0 9 0
... ...	1	0	... ...	0	5	... ...	1	0	5.5	...	0 11 0
... ...	1	0	... ...	1	0	... ...	1	0	6.0	...	0 12 0
... ...	0	5	... ...	1	0	... ...	1	0	5.5	...	0 11 0
... ...	1	0	... ...	1	0	Absent.	0	0	5.0	...	0 10 0
... ...	0	5	... ...	1	0	... ...	0	0	4.5	...	0 9 0
... ...	0	5	... ...	1	0	... ...	0	0	4.5	...	0 9 0
... ...	1	0	... ...	1	0	Scouring Drains.	1	0	6.0	...	0 12 0
... ...	1	0	... ...	1	0	... ...	1	0	6.0	...	0 12 0
... ...	1	0	... ...	1	0	... ...	1	0	4.0	...	0 8 0
											6 9 0

STATEMENT of Workpeople employed in the Woods and Plan-

DAYS OF THE WEEK.	MONDAY.	Days.	Hours.	TUESDAY.	Days.	Hours.	WEDNESDAY.	Days.	Hours.
DAYS OF THE MONTH.	14.			15.			16.		
STATE OF THE WEATHER.	Dry with high wind.			Cloudy but dry.			Partly cloudy and partly sunshine.		
THERMOMETER AT NINE A.M.	54°			48°			51°		
A. M'Gregor,	Thinning Sluggan Plantation.	1	0	Home Policy, Cleaning Walks.	1	0	Home Policy, Cleaning Walks.	1	0
J. Grant, . .	... ...	1	0	... ...	1	0	... ...	1	0
D. Ross, . .	... ...	0	5	... ...	1	0	... ...	1	0
W. Scott, . .	... ...	1	0	... ...	1	0	... ...	1	0
D. Fraser, .	Absent.	0	0	... ...	1	0	... ...	1	0
J. M'Donald,	... ...	0	0	... ...	1	0	... ...	1	0
W. Calder, .	Thinning Sluggan Plantation.	1	0	... ...	1	0	... ...	1	0
J. Watson, .	... ...	1	0	... ...	1	0	... ...	1	0
A. Robertson,	... ...	1	0	... ...	0	5	... ...	1	0
J. M'Cook, .	... ...	1	0	... ...	1	0	... ...	1	0
H. Cameron,	... ...	0	5	... ...	1	0	... ...	1	0
T. Low, . .	... ...	1	0	... ...	1	0	... ...	1	0
DAYS OF THE MONTH.	21.			22.			23.		
STATE OF THE WEATHER.									
THERMOMETER.									
A. M'Gregor,	Thinning in Eden Plantation.	1	0	Thinning in Eden Plantation.	1	0	Thinning in Eden.	1	0
J. Grant, . .	... ...	1	0	... ...	1	0	... ...	1	0
D. Ross, . .	... ...	1	0	... ...	1	0	... ...	1	0
W. Scott, . .	... ...	1	0	... ...	1	0	... ...	0	5
D. Fraser, .	... ...	1	0	... ...	1	0	... ...	0	5
T. Low, . .	... ...	1	0	... ...	1	0	... ...	0	5
J. M'Cook, .	... ...	1	0	... ...	1	0	... ...	1	0
H. Cameron,	... ...	1	0	... ...	1	0	... ...	1	0
A. Robertson,	... ...	1	0	... ...	1	0	... ...	1	0
J. Watson, .	... ...	1	0	... ...	1	0	... ...	1	0
W. Calder, .	... ...	1	0	... ...	0	5	... ...	0	5
J. M'Donald,	... ...	1	0	... ...	1	0	... ...	1	0

ations on the Estate of Lynmore, from 14th to 26th May 1860.

THURSDAY.	Days.	Hours.	FRIDAY.	Days.	Hours.	SATURDAY.	Days.	Hours.	Total No. of Days.	Rate per Day.	Amount.
17.			18.			19.					
Clear sunshine.			Cloudy.			Showery.					
54°			45°			48°					
Pruning Oaks in Rymore Plantation.	1	0	Pruning Oaks in Rymore Plantation.	1	0	Pruning Oaks in Rymore Plantation.	0	5	5.5	2/6	£0 13 9
... ...	1	0	... ...	1	0	Absent.	0	5	5.5	2/0	0 11 0
... ...	1	0	... ...	1	0	... ...	0	0	4.5	...	0 9 0
... ...	1	0	... ...	1	0	... ...	0	0	5.0	...	0 10 0
... ...	1	0	... ...	1	0	... ...	0	0	4.0	...	0 8 0
Absent.	0	0	... ...	1	0	... ...	0	0	3.0	...	0 6 0
... ...	0	0	... ...	1	0	... ...	0	0	4.0	...	0 8 0
Pruning Oaks in Rymore Plantation.	1	0	... ...	1	0	... ...	0	0	5.0	...	0 10 0
... ...	1	0	... ...	1	0	... ...	0	0	4.5	...	0 9 0
... ...	1	0	... ...	1	0	... ...	0	0	5.0	...	0 10 0
... ...	1	0	... ...	1	0	... ...	0	0	4.5	...	0 9 0
... ...	1	0	... ...	1	0	... ...	0	0	5.0	...	0 10 0
											£5 13 9
24.			25.			26.					
Cleaning Nursery.	1	0	Lotting Oak Timber for Sale, Adam's Wood.	1	0	Lotting Oak Timber for Sale, Adam's Wood.	1	0	6.0	2/6	£0 15 0
... ...	1	0	... ...	1	0	... ...	1	0	6.0	2/0	0 12 0
... ...	1	0	... ...	1	0	... ...	1	0	6.0	...	0 12 0
... ...	1	0	... ...	1	0	... ...	1	0	5.5	...	0 11 0
... ...	1	0	Absent.	0	0	... ...	1	0	4.5	...	0 9 0
... ...	1	0	... ...	0	0	... ...	1	0	4.5	...	0 9 0
... ...	1	0	... ...	0	0	... ...	1	0	5.0	...	0 10 0
... ...	1	0	... ...	0	0	... ...	1	0	5.0	...	0 10 0
... ...	1	0	Lotting Oak Timber, Adam's Wood.	1	0	... ...	1	0	6.0	...	0 12 0
... ...	1	0	... ...	1	0	Absent.	0	0	5.0	...	0 10 0
... ...	1	0	... ...	1	0	... ...	0	0	4.0	...	0 8 0
... ...	1	0	... ...	1	0	... ...	0	0	5.0	...	0 10 0
											£6 8 0

STATEMENT *of Day-Labour for the Month.*

First week, ...	£5 8 9
Second week, ...	6 9 0
Third week, ...	5 13 9
Fourth week, ...	6 8 0
	£23 14 6

1501. The foregoing system of keeping the particulars in regard to the labourers' time is so very clear and simple that little or no explanation seems necessary on it. Still, for the benefit of young and inexperienced men in the profession, I shall advert a little to it, and give such explanation as I think most likely to be useful.

1502. It will be observed from the heading of this copy of day-labour book, that the month begins on Monday the 30th April, which is supposed to be the first month of the business or financial year on the estate of Lynmore; but it must be clearly understood that no precise month needs be taken as the beginning of the year in making out such a statement, as this may be any month, according to the usual business year maintained on the property, in respect to the winding-up of financial affairs.

1503. Under the heading, the two pages are divided, from bottom to top, into seven great columns—apart from the money columns, &c.—the first on the left hand side for the names of the men employed, and the other six for the working days of the week; with intermediate small columns for the days and hours that each man is employed. After the days of the week, there is a column for the total number of days each man is employed during the week; next comes a column for the rate of wages he receives per day; and lastly comes one in the usual manner of money columns, in which the sum each man is to receive in that week is entered.

1504. If there are not many men employed, one opening of the book, or two opposite pages, will hold the transactions of two weeks; but if many are employed, it will take all the space of the two pages to do justice to the description of the work; and of course this must always be regulated according to the nature of the establishment. In giving the foregoing copy of our day-labour book, I have preferred to give it showing two weeks' labour on the opening of the book, with the view of showing how this is done when necessary; which is merely to draw the lines across the middle of the pages, as at the top of the pages.

1505. I have described the use of the columns divided by the upright lines on the pages. With regard to the horizontal lines, which intersect the others from side to side of the page, the first from the top is to make a column for the days of the week, which are stated each in its compartment, and at the head of its own special column. Immediately under this is another horizontal line from side to side, causing compartments at the tops of the several columns for the days of the month; and thus the days of the week and the days of the month are made to correspond to each other; next in order, and under the compartments for the days of the month, are those for the state of the weather, which should always be noted by the forester; and lastly, there is the line of compartments for the registry of the thermometer, which should also be regularly attended to, as shown in paragraph 1500.

1506. I shall carry my remarks a little farther, and show how the men's time is registered in this book; and, in order to this, I shall describe the entries made in reference to one or two of them. A. M'Gregor, the first man named on the list for the week ending on Saturday the 5th of May, is, under Monday the 30th April, stated as felling oak timber in Adam's Wood, and on the same day the other ten men were employed at the same work in the same wood. Of course, where the men are at different works, the work that each man is engaged in must be carefully described under the date, and in the compartment for the purpose. But I need not enlarge on this point, as the reading of the columns themselves are so clear that they can hardly be misunderstood.

1507. It will be observed that in the statement for the week ending Saturday the 12th May, the same man, A. M'Gregor, is registered on the 10th, and the following day, as repairing fences on the south district of enclosures, and that on the same days, all the other men were employed at the same work with him, but that on Saturday William Calder, James Watson, and H. Cameron, are marked absent, all the others being engaged in scouring drains in south district enclosures. All this, I think, is clear enough to be understood by any forester; still there are a few points yet to be remarked on the subject, which must be carefully noted.

1508. The particulars of each day's operations, so far as the labouring men are concerned, should be marked down in the evening, when the forester returns home, and should on no account be left till another day, when it is probable that new works will distract his mind, and prevent his noting so correctly the transactions of the previous day.

1509. The forester must always be careful, in the keeping the day-labour book, not only to note the different operations that the different men may have been engaged in during each day, but also to note very particularly the district or particular plantation on which the work has been performed, as without this he could not fill up satisfactorily the next book to be described (the Pay-List), neither could he note correctly, at the end of the financial year, when the different operations had been performed, in what plantation, or in what part of the estate the work had been done. This, therefore, should be kept specially in view by the forester. To the inexperienced book-keeper in forestry this may seem a matter of little consequence; but to the man who has had much experience in rendering correct accounts to his employer, it is found of vast importance, as will more particularly appear as we proceed with our proposed system.

1510. It is also necessary that the forester should, on the evening of each day, note in its proper place the general state of the weather, as well as the degree of the thermometer, at a given time of the day; I have noted it at 9 A.M. as a convenient time, but it ought to be taken at the height of the day also, and in the afternoon as well.

1511. Men employed in contract or piece-work, should not, of course, have their time noted in the book under notice, but only day-labourers, as the statement in respect to contract-work will be accounted for elsewhere.

1512. The day-labour book should be made so large as to last one year, so that reference can be made to each book for the labour of the year it represents.

The next book in the order of the system is the Pay-List of Day-Labour and Piece-work. The following is a sample of it:—

ACCOUNT

1513. nmore, for Month ending 26th May 1860.

Nos.	Names.	1. Adam's W Felling Timbe		11. Adam's Wood. Lotting Timber.				12.		13. Total No. of Days.	14. Rate per Day.		15. Total Amount.			16. We, the undersigned, acknowledge to have received from —— —— the sums set opposite our names respectively, as payment of our wages for the time herein set forth.
		Days.	Am	Days.	Amount.											
			£		£	s.	d.				s.	d.	£	s.	d.	
1.	A. M'Gregor, .	4.5	0 1	2	0	5	0			23.0	2	6	2	17	6	(Signed) A. M'Gregor.
2.	J. Grant, . .	4.5	0	2	0	4	0			22.½	2	0	2	5	0	„ J. Grant.
3.	D. Fraser, . .	4.0	0	1	0	2	0			19.½	2	0	1	19	0	„ D. Fraser.
4.	J. M'Donald, .	4.0	0	1	0	2	0			17.½	2	0	1	15	0	„ J. M'Donald.
5.	W. Scott, . .	3.5	0	2	0	4	0			20.5	2	0	2	1	0	„ W. Scott.
6.	D. Ross,. . .	2.5	0	2	0	4	0			19.½	2	0	1	19	0	„ D. Ross.
7.	W. Calder, .	2.5	0	1	0	2	0			16.½	2	0	1	13	0	„ W. Calder.
8.	A. Robertson,.	3.5	0	2	0	4	0			21.0	2	0	2	2	0	„ A. Robertson.
9.	J. Watson,. .	4.0	0	1	0	2	0			19.½	2	0	1	19	0	„ J. Watson.
10.	J. M'Cook,. .	3.5	0	1	0	2	0			20.½	2	0	2	1	0	„ J. M'Cook.
11.	H. Cameron, .	3.0	0	1	0	2	0			18.0	2	0	1	16	0	„ H. Cameron.
12.	T. Low,. . .	...		1	0	2	0			13.½	2	0	1	7	0	„ T. Low.
			4		1	15	0						23	14	6	
				Total Amount of Day-Labour,									23	14	6	

Nos.		r.	Rate per Yard.		Amount paid for Piece-Work.			Total			
			s.	d.	£	s.	d.				
13.	James Smith, Contra	ds	0	2	16	13	4				„ J. Smith.
14.	Angus Cameron,	„	0	8	33	6	8				„ A. Cameron.
15.	John M'Gregor,	„	2	0	120	0	0				„ J. M'Gregor.
		unt for Piece-Work,			170	0	0	170	0	0	
			Total Amount, . .					193	14	6	

1515. The specimen sheet just given of the book called the Pay-List of Day-Labour and Piece-Work, contains the entire labour transactions of the month, or four weeks, as particularised in the specimen given of the Day-Labour Book itself, together with the contract or piece-work performed and paid for during the same period. The day-labour part of the sheet, embraced under paragraph 1513, contains, in a condensed form, all the different works every man has been employed at during the month, and as particularised in the day-labour book, while the piece-work part of it, embraced under paragraph 1514, contains also in a condensed form, but with all the particulars necessary for the proper description for payment, the contract-work that has been performed and falls to be accounted for, for the month.

1516. As an example, we shall take up the time of the man, Alexander M'Gregor, who is first named on the list, and whose number is therefore 1. Under column number 1, he is set down as having been 4 days and 5 hours employed in felling oak timber in Adam's Wood; under the 2d, as having been 3 days engaged in thinning Bankhead Plantation; under the 3d, 1 day employed cleaning hedges on North Park; under the 4th, 2 days in the repairing of fences on the enclosures of the South District; and so on, with the days set down opposite to his name. On summing up the whole of this man's time, it will be found to be 23 days in all, which is the number set down for him to receive payment for, under column 13, which contains the total number of days each man has been employed during the four weeks. Under column 14, it will next appear, in respect to this man, that his rate of wages is 2s. 6d. per day; consequently his 23 days at this rate amount to £2, 17s. 6d., which is set down in column 15; and on his receiving this pay, he acknowledges it by signing his name on a stamp, under the 16th column; and so on with all the other men whose names follow on the sheet, each man signing his name on a stamp when his amount is £2 and upwards. This, I think, is sufficient explanation on this point.

1517. By examining Alexander M'Gregor's time, as stated in the day-labour book, it will be found that it exactly corresponds with the number of days set down for him in the pay-list, which, of course, ought to be the case in respect to all the men's names set down in these statements, as if the one statement do not correspond with the other in this respect, it is an indication that there is an error somewhere, which, of course, should be checked.

1518. The great advantage of this mode of keeping men's time is, that it forms a complete account of all that they are employed at, in the least possible space, and yet is as clear and to the point as if volumes were written in regard to it. It is a system entirely of my own invention, for Lord

Seafield's workmen's time, and I find it answer our purpose admirably, and form a complete receipt for all day-labourers' wages.

1519. The great advantage I find to result from this mode of keeping our pay-list for workmen is, its bringing out, at the end of each month, the exact expense that has been incurred on each branch of work. For example, we at once see that £4, 1s. 3d. has been expended under column No. 1, for felling oak timber in Adam's Wood; £3, 5s. 6d., under column No. 2, for thinning Bankhead Plantation; and so on, with the sums set down under each of the headings; and as each of the headings of the columns is filled up every month, as the different works require, these sheets, at the end of the year, form a complete history of the workman's time, which is of vast importance in the keeping of correct accounts on all such matters, and in making up the actual amount of expenditure at the end of the year.

1520. It will be observed, at the end of paragraph 1500, that the statement of day-labour for the four weeks amounts to £23, 14s. 6d. in all, and that this corresponds with the sum brought out as the result of the expenditure in the pay-list at the end of paragraph 1513. This point should, of course, be particularly attended to, as, if an error occur, and the accounts do not correspond, it might lead to a great amount of labour at the end of the year.

1521. I have yet to make a few remarks in respect to that part of the pay-list which sets forth the contract, or piece-work performed during the month, and which is entered under paragraph 1514, and on the same page or sheet with the day-labour. It is necessary and desirable that both should be entered on one sheet, in order to bring out the whole as one account at the end of the month.

1522. Before entering into any bargain with parties to perform such work, we have specifications drawn up on stamped paper, setting forth all particulars in regard to it, which specifications are of course signed by the contracting parties. This arranged, we have next a formal agreement drawn up, also on stamped paper, setting forth the general conditions of the bargain, one condition being always, that we are to pay them for such part of the work as may be finished to our satisfaction, at the end of each month, and that their signing our pay-list for any such portion as shall be paid for at the end of any month, shall be held as a sufficient receipt for such sums as they may receive on the work, progressively. This, then, explains our mode of going to work in such works as we contract for, apart from day-labour.

1523. From the statement on the pay-list, as to the piece-work for the month, it appears that James Smith had opened two thousand yards of drains in Braidwood Hill enclosure, at 2d. per yard; that Angus Cameron had erected one thousand yards of four-barred paling as a fence on the same enclosure, at 8d. per yard; and that John M'Gregor had erected twelve hundred yards of stone wall on the enclosure of Thortown, at 2s. per yard, the sums of all of which are set down and paid, and signed by the parties, each opposite to his account.

1524. From both branches of this statement, then, it is brought out that £23, 14s. 6d. was paid for day-labour during the month, and £170 for piece-work—or in all, £193, 14s. 6d., which the forester will set down in his cash-book accordingly.

1525. The cash-book is the next one in the order of the system, and this I keep by single entry, or single money columns. In this book every sum is entered as it is paid, for whatever purpose, taking care to have a receipt for the smallest sum paid, for whatever it may be. This is absolutely necessary in the case of the forester, as he must of course render a proper account of his employer's money. The following page will show my mode of keeping an account of all sums paid out:—

1526. John Woodford, in account with Lord E——d. *Cr.*

1860. May 8.	Paid Robert Manfred for scouring drains in Stockston Plantation, per contract, as per agreement and receipt,	£7	10	0
" "	Paid James Strachan for one quarter of oats, for forest horse, as per account,	1	2	0
" "	Paid Samuel Walker for paper, note-books for foremen, pens and ink, &c., for the forester's office, as per account,	1	3	6
" 15.	Paid as travelling expenses, two days in visiting southern district of plantations,	0	15	0
" "	Paid Robert Dickson for axes, saws, and hammers for workmen on western district of plantations, as per account,	4	8	6
" 16.	Paid John Mathewson, Carpenter, Newlands, for a new cart for forest work, as per account,	5	18	0
" "	Paid Robert Welbeck for erecting a new tank in Bancroft Wood, in which to prepare timber for fencing purposes, as per account, with specification,	4	6	0
" 23.	Paid as travelling expenses, three days in inspecting operations on the western district of plantations,	1	2	6
" 26.	Paid pay-list of day-labour and piece-work, performed in the woods and plantations, for the month ended on the 26th instant, as per pay-list,	193	14	6
	Carry forward,	£220	0	0

1527. From the foregoing example of the mode of keeping the cash-book, it will appear a simple and easy matter to the forester thus to note down, as he pays any account, the particulars of it, on the exact date of the transaction; and this noting down of the sums the forester may have occasion to pay is so easily understood, that I think the example page, which is supposed to contain the transactions of one month of four weeks, is sufficient, without much explanatory comment.

1528. For the information of young men, however, who may not have had the opportunity of much school education on the subject of book-keeping, I shall make a few general remarks in explanation of the items set down as paid in the cash-book. The first of these is £7, 10s. for scouring drains in Stockston Plantation. Now, with reference to this, it is to be clearly understood that the forester, in making an agreement with a party for the performance of such work, should have a written statement drawn out setting forth the nature of the work, and how it is to be done, and that this agreement should be signed by the party contracting for it. This attended to, when the forester pays the contractor, he should take a proper receipt from him, and fold this up along with the agreement, both of which should be properly labelled on the back, or outer fold, so as the more readily to distinguish them at a glance from other documents, among which they may happen to be laid. They may both be labelled in the way shown under:—

AGREEMENT.

ROBERT MANFRED,
for Scouring Drains,
Stockston Plantation,
1*st* *May* 1860.

RECEIPT.

ROBERT MANFRED,
for Scouring Drains,
Stockston Plantation,
£7, 10s.
8*th* *May* 1860.

1529. Having settled in regard to the agreement for the scouring of the drains, and paid for the work, both the agreement and receipt should be, as already said, tied together, and laid past in a drawer, which should be kept exclusively for the purpose of holding such documents. The advantages of such a mode of arrangement will be felt by the forester when, at the end of the year, he comes to make up a full statement of his accounts.

1530. The same mode of dealing with the other accounts should be maintained throughout; and the forester should never omit, when he pays out money on his employer's business, to procure a proper receipt for it, and next to enter the sum in his cash-book, on the exact day on which it was paid, and to label the receipt, or, it may be, account, and lay it past in due order in his drawer.

1531. With regard to the forester's own expenses, it is not necessary that he should show a receipt for every small sum he may have occasion to pay out while travelling on his employer's business. It will, generally, be enough if he present an account of such expenditure at the end of a month, or at the end of a year, according as his books are settled; but, for correctness, he should never neglect to enter in his cash-book the sums for travelling, as they are paid.

1532. With regard to the account entered in the cash-book for day-labour and piece-work, amounting to £193, 14s. 6d., it is of course understood that the receipts for the various items which go to make up this sum, are shown in the pay-list itself, and therefore reference is made to this book in the cash-book, where the receipts of the parties are to be seen.

1533. In the same way, the forester will enter all sums he pays out during the year in the cash-book; and, at the end of the year, when the accounts are to be arranged for settlement, they will fall to be entered in another book, a copy of which will be given in its place.

1534. The foregoing copies of books are, I think, enough for all purposes, in reference to the keeping of an account of the expenditure. I shall next show copies of my mode of keeping books in reference to the income from woods. The first is what I call "The Private Sales Book," a copy-sheet of which is given on the next page.

1535. The example, or copy-sheet, of our mode of keeping an account of sales by private contract, is given under paragraph 1538; and this embraces all sales of timber for which ready money is received. A book ruled in the way shown is, I think, the most suitable of any form for registering small sales as they occur from time to time, and for which the money is paid at once; as in such cases it is not necessary to show anything other than the simple nature of the transaction, without reference to anything future in regard to it.

1536. The column on the left-hand side of the form is, of course, for the entering of the dates when the different sales are made; the next column is for the names of the purchasers, and after it is a column for their residences. Next in succession is a column for the names of the different plantations from which the timber was sold, and following this is another for the description of wood. All this, I think, is clearly shown on the copy itself.

1537. As a matter of convenience for entering the different quantities of wood sold, I have five columns divided off respectively for selling quantities:—1, per ton; 2, per hundred trees; 3, per dozen trees; 4, per tree; and, 5, per foot. This arrangement makes the different matters of entry more simple than could otherwise be in a book of this kind, where brevity, combined with explicitness, is very desirable. I shall just describe a few of the entries given in this example.

1538. SALES OF TIMBER by Private Contract, in the Woods and Plantations on the Estate of Lynmore, during the month of May 1860.

Date.	Names of Purchasers.	Residence.	Plantations from which Sold.	Description of Timber.	1. Tons.	2. Hundred Trees.	3. Dozen Trees.	4. Trees.	5. Feet.	Rate.	Amount.	Total.
1860. May 1,	J. Ross,	Laggan,	Sluggan,	Small Oaks,	...	7	...	...	...	£5 0 0	£35 0 0	
„ 3,	J. Grant,	Eden,	Burnside,	Scots Pine Thinnings,	...	9	...	...	...	2 10 0	22 10 0	
„ 4,	W. Urquhart,	Do.,	Do.,	Paling Rails,	...	...	145	...	...	0 3 0	21 15 0	
„ 14,	J. Calder,	Damhead,	Eden,	Burnwood,	50	...	...	...	...	0 15 0	37 10 0	
„ 17,	G. Wallace,	Burnside,	Strawn,	Birch, for Powder Wood,	76	...	...	...	...	1 2 0	83 12 0	
„ „	D. M'Donald,	Clury,	Clury,	Scots Pine,	...	...	...	40	...	0 7 6	15 0 0	
„ 19,	J. Cumming,	Smiddy Boyne,	Adam's Wood,	Oak,	...	...	...	...	270	0 2 6	33 15 0	
„ „	G. Ogilvie,	Tulloch,	Lait,	Larch,	...	...	...	...	590	0 1 0	29 10 0	
„ 23,	W. Scott,	Broomhill,	Do.,	Spar Wood,	...	...	30	...	...	0 18 0	27 0 0	
„ 24,	J. Dundas,	Craggan,	Damhead,	Firewood,	25	...	...	...	...	0 6 0	7 10 0	
„ „	G. Stewart,	Slapp,	Do.,	Ash,	...	...	...	...	75	0 1 6	5 12 6	
„ 25,	A. Cameron,	Do.,	Strawn,	Elm,	...	...	...	...	215	0 1 8	17 18 4	
„ „	R. Ewan,	Clayfolds,	Do.,	Decayed Trees,	...	...	...	27	...	0 1 0	1 7 0	
												£337 19 10

1539. PAYMENTS FROM CREDIT ACCOUNTS IN LEDGER.

„ 17,	J. Gordon,	Miltown,	By Cash per Credit Account in Ledger, folio 1,	£150 0 0	
„ 23,	A. M'Gregor,	Craigbea,	Do. do. do., folio 2,	68 0 0	
„ 26,	W. Nisbet,	Woodhead,	Do. do. do., folio 3,	120 0 0	
					338 0 0
					£675 19 10

1540. The first entry made is in the name of John Ross, residing at Laggan, who, it appears, on the 1st of May, purchased from the plantation of Sluggan small oaks, to the number of 700 trees, at £5 per 100, amounting to £35 in all. Passing the purchase made by James Grant, on the 3d of May, I shall refer to that made by William Urquhart, of Eden, on the 4th. From the account, it is set forth that, on that date, he had purchased from the plantation of Burnside, paling rails, to the amount of 145 dozens of trees, at 3s. per dozen, and that the amount of his purchase is £21, 15s. I shall only refer to another sale, namely, that on the 14th, to James Calder, of Damhead, who, it seems, bought from the plantation of Eden, burnwood to the extent of 50 tons. This, it will appear, had been sold to him at 15s. per ton, and that he had paid for it on the same date he made his purchase the price named—viz., £37, 10s. in all.

1541. In entering such sales, they can be carried forward from page to page, to any desired extent. I have only shown a few, simply to illustrate my mode of keeping an account of such transactions. This may be one week's or one month's transactions; but I have supposed it to be one month's.

1542. One great advantage resulting from this mode of keeping an account of wood sales is its simplicity and its correctness; and, not the least, its pointing out at a glance from what plantation each sale was made. The latter is a very great advantage when correct accounts of the produce from each plantation is an object, and it ought always to be one in every well-regulated establishment, as without such information the management of woods can never be clearly defined as to income and expenditure. In short, it is, in my opinion, of the greatest importance to be able to ascertain, at any time, what value of produce has been taken from a given plantation, as without this no proprietor can say whether such and such a plantation has paid him better than such another, or whether it has paid him at all.

1543. In paragraph 1539 of the same copy is also shown an account of payments made during the month by purchasers who had bought timber on credit,—that is, this class of purchasers had bought produce from the woods on the understanding that they were to have a certain time allowed them to make payment, and that they were to do so as they found it convenient, within a reasonable time. Sales of this description are entered into another book, kept specially for the purpose, which is called the "Ledger." Before describing the nature of the entries made under paragraph 1539, I shall give a copy of the mode of keeping the account of such credit sales in the ledger. A copy of this book follows:—

1544. *Dr.* John Gordon, Wood-merchant, Miltown.

1860.	Plantation from which Sold.	Description of Timber.	Tons.	Hundred Trees.	Dozen Trees.	Trees.	Feet.	Rate.	Amount. £ s. d.
May 4,	Clury,	Scots Pine,	...	...	...	370	...	at 9/	166 10 0
„ „	Lait,	Larch,	...	...	...	280	...	at 15/	210 0 0
„ 17,	Clury,	Scots Pine,	...	...	...	...	1160	at /9	43 10 0

1545. *Dr.* Alexander M'Gregor, Wood-merchant, Craigbea.

1860.	Plantation from which Sold.	Description of Timber.	Tons.	Hundred Trees.	Dozen Trees.	Trees.	Feet.	Rate.	Amount. £ s. d.
May 1,	Burnside,	Scots Pine Propwood,	...	...	290	...	...	at 4/	58 0 0
„ 3,	Lait,	Larch Propwood,	...	...	340	...	...	at 6/	102 0 0

1546. *Dr.* William Nisbet, Saw-miller, Woodhead.

1860	Plantation from which Sold.	Description of Timber.	Tons.	Hundred Trees.	Dozen Trees.	Trees.	Feet.	Rate.	Amount. £ s. d.
May 14,	Clury,	Scots Pine,	...	...	...	235	...	at 8/	94 0 0
„ 19,	Damhead,	Small Ash,	...	...	50	...	...	at 15/	37 10 0
„ „	Strawn,	Small Sycamore,	...	...	30	...	...	at 10/	15 0 0

1547. *Dr.* John Maxwell, Wood-merchant, Burnside.

1860.	Plantation from which Sold.	Description of Timber.	Tons.	Hundred Trees.	Dozen Trees.	Trees.	Feet.	Rate.	Amount. £ s. d.
May 17,	Adam's Wood,	Oak Timber,	...	...	...	...	1200	at 2/3	135 0 0
„ 23,	Do.,	Oak Burnwood,	110	...	...	...	...	at 12/	66 0 0
„ 26,	Clury,	Oak Spokewood,	...	...	...	500	...	at 1/6	37 10 0

1548. *Dr.* Peter Grant, Wood-merchant, Ballintua.

1860.	Plantation from which Sold.	Description of Timber.	Tons.	Hundred Trees.	Dozen Trees.	Trees.	Feet.	Rate.	Amount. £ s. d.
May 1,	Clury,	Scots Pine,	...	...	...	700	...	at 8/	280 0 0
„ 14,	Do.,	Do.,	...	...	...	...	1300	at /9	48 15 0
„ 26,	Do.,	Scots Pine Paling Wood,	...	...	70	...	...	at 8/	28 0 0

CONTRA. *Cr.*

0.	Mode of Payment.	Discount.	Sums Paid.		
			£	s.	d.
17,	By Cash to Account, ...	... ...	150	0	0

CONTRA. *Cr.*

1.	Mode of Payment.	Discount.	Sums Paid.		
			£	s.	d.
23,	By Cash to Account, ...	... ...	68	0	0

CONTRA. *Cr.*

'.	Mode of Payment.	Discount.	Sums Paid.		
			£	s.	d.
26,	By Cash to Account, ...	... ...	120	0	0

CONTRA. *Cr.*

	Mode of Payment.	Discount.	Sums Paid.

CONTRA. *Cr.*

	Mode of Payment.	Discount.	Sums Paid.

1549. From the examples shown in regard to the ledger, it is set forth that five different persons have opened accounts with the forester in the month of May, for purchases of timber made by them respectively on credit—viz., John Gordon, at paragraph 1544; Alexander M'Gregor, at paragraph 1545; William Nisbet, at paragraph 1546; John Maxwell, at paragraph 1547; and Peter Grant, at paragraph 1548.

1550. From paragraph 1545, it appears that John Gordon, on the 4th of May, purchased from the Clury Plantation 370 trees, at 9s. each, amounting to £166, 10s.; that, at the same time, he purchased also, from the Lait Plantation, 280 larch trees, at 15s. each, amounting to £210; and that on the 17th, he purchased again, from the Clury Wood, 1160 feet Scots pine, at 9d. per foot, amounting to £43, 10s. These entries of sale, it is to be observed, are all entered on the left-hand, or debtor, page of the book, and regularly according to their dates. On the contra, or right-hand, page of the book, however, it will be observed that this John Gordon, on the day that he made his last purchase in Clury Plantation—on the 17th—had paid to the forester £150. This sum, then, is entered on the right-hand page under date the 17th May, and on this side all sums are entered as they are paid.

1551. The nature of this book, then, called the ledger, is simply that the sales made are entered on the left-hand page of the book, and the payments, as they are made, are entered on the opposite page, when, at any time, it can be seen at a glance what sums are due and what paid; and of course when the sums on both sides are equal, the account is said to be balanced or settled.

1552. In the same way as has been described under paragraphs 1550 and 1551, all the accounts in the following pages of the copy of the ledger are entered and dealt with, and in a book of this kind there may be any number of purchasers entered for transactions, according to the extent of the sales made, on the principle of credit accounts, observing to give each purchaser a double page for his account. In making such sales, however, the forester requires to be very careful as to whom he deals with, as if they do not happen to be good men, from having no hold upon them beyond the timber lying in the plantations, he might incur heavy losses to his employer; this, therefore, ought to be kept specially in view in carrying on such transactions.

1553. I shall now refer to the account given under paragraph 1539, which we could not well have attended to till now, and which is set down under the private sales as payments on credit accounts in ledger. In looking over this statement, then, it appears, first, that on the 17th of May, John Gordon, of Miltown, had paid cash, as per credit account in ledger, folio (leaf or page) 1, £150. Now, by taking up the copy given of the ledger, and examining John Gordon's account, given at page 1 of the ledger, this will be seen to correspond with the transaction as it took place, for at page 1 of the ledger, £150 is entered, on the right-hand side of the page, to the credit of John Gordon. Next, from the statement under paragraph 1539, it appears that Alexander M'Gregor had paid, on the 23d of May, cash to the amount of £68, and for the particulars of the transaction, the statement refers to the ledger at page or folio 2. Looking up for this in the ledger, then, at page 2, it is seen that this exactly corresponds with the transaction, for £68 is entered to the credit of A. M'Gregor in the account opened up with him at page 2. Again, it next appears, that on the 26th May, John Nisbet had made a payment of £120; this is referred to the 3d page of the ledger, where the transactions in reference to this person are fully particularised on the left-hand page, and on the right it is shown that on the 26th of May he paid in the sum stated, and this he is given credit for in the usual way.

1554. The payments made from these three men are all set down under paragraph 1539, and amount in all to £338, which is set down in the columns for the total receipts of the month, and under the totals received from the ready-money sales, and thus it is brought out that the amount received for timber, by sales by private contract, during the month of May, is in all £675, 19s. 10d., all the particulars in regard to which sales are seen in the ready-money transactions under paragraph 1538, and in the ledger where the credit sales are particularised at the pages of this book referred to under paragraph 1539.

1555. This is all so plain that I think little further comment is required on the subject. I must remark, however, that the parties whose transactions are particularised under paragraphs 1547 and 1548 of the ledger, or on the 4th and 5th pages of that book, are represented as having made no payments in the month of May. This of course is known by no sums being entered to their credit on the right hand pages of their accounts; so that all the timber they have bought is supposed to be still due.

1556. We now come to take up the subject of registering the transactions of sales of timber by public auction, which, generally speaking, are more complicated than those by private contract, inasmuch as the transactions are generally more extensive than private ones are, and also as they are to be guided by a class of rules understood to be previously laid down to be attended to by the seller on the one part and by the buyer on the other.

1557. For the sake of illustrating how public sales of timber should be registered in a book, I shall suppose that we have to dispose of the larch and pine trees referred to in the statement given in regard to the estimate of the probable income under paragraph 1492. By referring to that paragraph, it will be observed that we proposed there should be sold, from the Hill of Bands, by public auction, 10,000 larch trees, and we supposed that they would amount in value to 10s. each, or £5000 in all. We also proposed that there should be 12,000 Scots pine trees sold from the plantation of Gory, and that they should bring 6s. each, or £3600 in all. The oak timber referred to in the paragraph under notice we shall take no account of at present, as it is to be understood that it cannot be had stripped and in readiness for sale so early as the month of May, when that sale of pine and larch is supposed to take place.

1558. Preparatory to this sale, then, the quantity of trees stated should be properly divided into lots, of various numbers, to suit the views of small and large purchasers, and to induce competition so as to realise the highest possible price for each lot, and for the whole.

1559. I shall now suppose that this has been done, and that the 10,000 larch trees to be sold have been properly marked and arranged for sale; and that they are subdived into 10 different lots, varying from 250 to 3000 trees; and that the 12,000 Scots pines have been dealt with in a similar manner, and subdivided into 17 different lots, varying from 250 to 2000 trees each; making in all 27 lots to be disposed of. These arrangements all made, and the timber sold, say on the 4th day of May, we should enter the different lots, and the whole of the money transactions in regard to them, in a book for the purpose, as shown in the next page, and which is in every respect a copy of the way I keep my own books for the registering of similar transactions.

1. District or Plantation in which Sold.	2. Date of Sale.	3. No. of Lot.	4. Description of Timber.	5. Quantity.	6. Name of Purchaser.	7. Residence.	8. Rate.	9. Value.	10. Total Amount.	11. Discount.	12. Date of Payment.	13. Cash Received.	14. Sums Due.	15. Date of Full Payment.	16. Full Payment.	17. Remarks.
				Trees.				£	£		1860.	£ s. d.	£ s. d.			
Hill of Bands,	May 4,	1	Larch,	3000	J. Ream,	E——d,	Per Lot,	1700								
...	...	2	...	500	...	...	...	260	1960		May 4,	490 0 0	1470 0 0			Settled by Bill at 4 & 8 months after date.
...	...	3	...	300	J. Morison,	E——d,	...	160	160		...	40 0 0	120 0 0			...
...	...	4	...	400	R. Murray,	L——e,	...	200								
...	...	5	...	250	...	...	...	140								
...	...	6	...	450	...	...	...	270	610		...	152 10 0	457 10 0			...
...	...	7	...	2000	J. Ramsay,	K——o,	...	1050								
...	...	8	...	1000	...	...	...	600	1650		...	412 10 0	1237 10 0			...
...	...	9	...	1500	J. Kemp,	L——l,	...	800	800		...	200 0 0	600 0 0			...
...	...	10	...	600	R. Webster,	L——e,	...	300	300		...	75 0 0	225 0 0			...
			Trees,	10,000					5480			1370 0 0				
Plantation of Gorry,	...	11	Scots Pine,	1000	J. Nicholson,	N——e,	...	310								
...	...	12	...	500	...	...	...	170								
...	...	13	...	500	...	...	...	150								
...	...	14	...	700	...	...	...	230								
...	...	15	...	300	...	...	...	100	960		...	240 0 0	720 0 0			...
...	...	16	...	500	R. Reid,	L——d,	...	160								
...	...	17	...	1000	...	...	...	340								
...	...	18	...	700	...	...	...	220	720			180 0 0	540 0 0			...
...	...	19	...	300	S. Johnston,	W——e,	...	100	100		...	25 0 0	75 0 0			...
...	...	20	...	800	J. Grant,	G——n,	...	250								
...	...	21	...	700	...	...	...	240	490		...	122 10 0	307 10 0			...
...	...	22	...	2000	W. Stewart,	G——n,	...	650								
...	...	23	...	2000	...	...	...	580	1230		...	307 10 0	922 10 0			...
...	...	24	...	250	R. France,	E——h,	...	80								
...	...	25	...	250	...	...	...	75								
...	...	26	...	250	...	...	...	70								
...	...	27	...	250	...	...	...	74	299		...	74 15 0	224 5 0			...
			Trees,	12,000					3799			949 15 0				

1561. This, then, is the form of book in which I register all our sales of timber by public auction; I have adopted it for a number of years, and have found it to answer all purposes admirably. The headings point out the different branches into which it is divided, so that little description is required in explanation. I shall, however, make a few remarks to show the way of going to work in putting down the particulars of a sale.

1562. The 1st column, as indicated by the heading, is for entering the names of the plantations in which the timber is sold; and the 2d, the date on which the sale took place. Here, then, from the reading of the first line, we find that the sale took place in the plantation called the Hill of Bands, and on the 4th day of May. The 3d column indicates the numbers of the respective lots sold; the 4th, the kind of trees the lots consisted of; and the 5th, the number of trees in each lot respectively; so that in continuing the reading of the first line, we see that the first lot consisted of larch to the extent of 3000. The 6th column indicates that this lot was sold to John Ream, and the 7th that his residence is at E——d; the 8th, that the timber is sold *per lot,* without reference to any other specified quantity or mode of measurement; the 9th, that the entire value of the 1st lot, as purchased by him, is £1700. The first line finishes at this point because the same John Ream has bought also lot 2, which consists of 500 larch trees, sold to him at the price of £260. These two sums, then, £1700 for lot 1, and £260 for lot 2, make £1960 as the total amount of this person's purchase, and this is therefore set down in the 10th column, which is adapted by its heading for this purpose. Passing the 11th column, which is set apart for entering any discounts that may be allowed, we read in the 12th and 13th columns that on the 4th day of May, the day on which the timber is supposed to have been sold, John Ream paid, as the fourth part of the price of his purchases, £490, in conformity with the conditions of the sale. Next, from column 14th, we see at a glance that this purchaser is due after the sale, and after he has made his first part payment, £1470, which constitutes exactly three-fourths of the price of his purchases. Columns 15 and 16 are for use when further payments come to be made, and therefore, in the mean time, are left blank till full payments are made. But from the 17th column we see that John Ream settled for the balance due by him, by granting his bills for payment at four and eight months after the date of the sale, and so on with all the other lots as they are shown under the names of the different purchasers respectively. From this tabular statement, therefore, a most complete account is given of each of the lots sold, in a clear, distinct, and satisfactory manner for after reference.

1563. I know of no system of book-keeping which is so well adapted to answer the purpose of sales by public auction as that given in the foregoing form, as it is simple and clear, as well as concise, and therefore taking up little space in a book.

1564. It is to be observed, under the 3d column, that the larch timber is embraced in the first 10 lots, and was therefore first sold; that the Scots pine timber commences at lot 11, and is embraced in the following lots to 27; and the number of larch trees (10,000), it will be observed, corresponds with the number stated in the estimate of proposed income stated under paragraph 1492 as proposed to be sold, and the number of Scots pine (12,000) also corresponds with the number mentioned in that statement. But on comparing the result of the sale with the sums stated as the value of the trees respectively in the estimate of proposed income, it will be found that there is a considerable difference.

1565. Under paragraph 1492, it is set forth in reference to the income expected from the 10,000 larch trees, that their value might probably be £5000, and in reference to the 12,000 Scots pine trees, that their value might probably be £3600; while the result of the sale, in the 10th column, shows £5480 for the larch, and for the Scots pine £3799, thus making, as the sum realised in all, £9279—instead of £8600, as was expected, or £679 more than the estimated value. Such a result as this indicates often takes place at public sales, as, however judiciously any forester may value his wood, it may bring more or less, according to the demand for the sort of timber at the time of sale.

1566. Having made the foregoing remarks in explanation of the form of book for public sales of timber, I do not think it necessary to make any further remarks on the subject, but request the young forester to consider and study, very carefully, the character of the different books I have given copies of, for all the purposes of expenditure and income. Unless he do this, and get a clear view of the whole subjects the copies are meant to present to him, he will never be able to keep correct accounts, whether of expenses for work performed or of income from produce sold. The foregoing copies of books are all absolutely necessary for every forester to keep, in order to be able to lay before his employer a sensible and intelligent statement at the end of the year, of all the transactions and works he has had performed, and of all the produce he has sold. Without some such system, the business under his charge must eventually run into confusion.

1567. The books I have given copies of, and described, are as follows :—

1st, Estimate of the Probable Income from, and Expenditure on, the Woods and Plantations on the Estate of (supposed to be) Lynmore, for the Year from 30th April 1860 to 1st May 1861. This book may be of any convenient size to suit the extent of business likely to be performed, and ought at least to contain so many pages as to admit of its holding transactions for a considerable number of years, and it may be had to order, from any stationer in a large town, ruled as shown in the copy, bound and ready for use; of course, in the forester ordering such a book from a stationer, he will require to give him a specimen copy to guide him in the ruling of it. The principal headings may be all printed, which will give the book a neater and more business character.

2d, THE DAY-LABOUR BOOK (copy shown from paragraph 1500 for the first four weeks of the supposed year). This book should be made to contain the labour transactions of one year, and should be labelled outside, DAY-LABOUR BOOK, FOR THE WOODS AND PLANTATIONS ON THE ESTATE OF ———, FOR THE YEAR ———. Such a book may also be had from any stationer, by giving him a copy to rule from; and all the headings should be printed, which will be a saving of time to the forester, and be the means of preventing mistakes.

3d, ACCOUNT OF DAY-LABOUR AND PIECE-WORK PERFORMED IN THE WOODS AND PLANTATIONS, &c., as shown under paragraphs 1513 and 1514. This book should also be made to hold the transactions of one year, and, as in the case of the Day-Labour Book, should be labelled outside; when, at the end of the year, both can be laid past as documents together, for the same year.

4th, THE CASH BOOK, as shown under paragraph 1526. This one may be of any convenient size to suit the transactions of the estate, and is most convenient when so large as to hold the transactions of a considerable number of years.

The four foregoing books are all that are necessary in connection with the labour department of the woods, as there cannot possibly take place any description of labour which may not be properly detailed in them, and attested by the parties performing it. With these general remarks on them, I shall proceed to give a similar short sketch in reference to the books for Income, copies of which have been described in their respective places:—

5th, ACCOUNT OF SALES OF TIMBER BY PRIVATE CONTRACT, as shown under paragraphs 1538 and 1539. This description of book may be made either of dimensions sufficient to hold the sales of one year only, or those of several years, according to the business habits of the proprietor. We ourselves have ours of so many pages as to hold the sales of several years, and this, I think, is the most convenient way.

6th, THE LEDGER, as shown from paragraph 1544 to 1548. This is a book which requires to be generally pretty large, in order to admit of a few pages being set aside for each purchaser; and it should also be provided with an alphabetical index at the beginning, by which to find out the names of the parties to whom the wood is sold. This is of course managed by the parties' names being registered on the index, according to the first letter of their names; and where the parties' names are registered in the index, reference is made to the page of the book where their particular transactions are detailed.

7th, ACCOUNT OF SALES OF TIMBER BY PUBLIC AUCTION, &c. This description of book is a very important one on most wooded estates, and, therefore, it should be made of a pretty large size, and sufficient to hold the transactions of several years.

1570.. *Dr.* Co hore, *from the* 30*th April* 1860 *to* 1*st May* 1861.

1. Name of District from which sold.	6. ctual and Estimated Income. 3. Sums under Estimate.	4. Sums over Estimate.	5. Difference betwixt actual and estimated.	REMARKS.
	£ s. d.	£ s. d.	£ s. d.	
Hill of Bands, . .		480 0 0		
Gorry Plantation, . .		199 0 0		
Adam's Wood, . .	250 0 0			£234, 15s., included in private sales.
Burnside, Woodhead, Clury, Laggan, and Lait, ...		124 15 6		
Rettie, Sluggan, and Eden, . . .	45 11 0			
Damhead and Strawn Plantations, . .	15 9 8			
Adam's Wood, . .		234 15 0		This sum, although realised from private sales, was estimated on public sales from Adam's Wood.
" " . .		59 15 0		
Sluggan and Eden, .	120 15 0			The weight of bark actually got from these woods is 13 tons under that estimated for, and the price per ton is also 10s. under that estimated for.

VALUE of

Name of Plantation in w				
Thortown Bridge, .				
Do. do. .				
Do. do. .				
Do. do. .				
Braidwood Hill, . .				
Do. do. . .				40,000 Scots pine were used in the Thortown Bridge enclosure, as per statement of expenditure on planting.
Westergates, . .				
			766 9 10	Over.

FOREST OPERATIONS.

on the **Estate** of Lynmore, *from the* 30*th April* 1860 *to* 1*st May* 1861. *Cr.*

Comparison of Actual and Estimated Expenditure.				Remarks.
Estimated Expenditure.	Sums under Estimate.	Sums over Estimate.	Difference betwixt Actual and Estimated.	
£ s. d.	£ s. d.	£ s. d.	£ s. d.	
8 0 0	3 4 8			
		6 2 6		Not estimated for.
8 0 0			2 17 10	Over.
4 0 0		0 3 4		
1 15 0		0 1 8		
0 15 0				
22 10 0		1 5 0		
22 10 0	2 10 0			
0 10 0				
1 0 0	0 1 3			
0 15 0		0 5 0		
3 2 6		0 12 6		
25 0 0		2 10 0		
6 0 0	0 4 0			
87 17 6			2 2 3	Over.
25 1 0	6 5 0			
8 0 0	1 3 0			
6 0 0		2 1 9		
7 0 0		0 11 5		
5 0 0		1 15 0		
51 1 0			2 19 10	Under.
25 0 0		5 15 6		
8 0 0		7 11 10		
35 0 0	7 14 6			
4 0 0		6 17 0		
10 0 0		2 19 0		
8 0 0	0 17 6			
25 0 0		1 10 0		
30 0 0				
3 0 0		1 3 6		
15 0 0	2 5 0			
10 0 0		5 12 7		
5 0 0		1 5 6		
10 0 0	0 2 6			
80 0 0		7 3 7		
268 0 0			28 19 0	Over.
3761 4 10			8 5 1	Under.

1568. All the seven books referred to should be well bound, and never slimly in paper boards, as when they are so, from the great amount of handling they must necessarily get, they soon become shabby-looking, and, in fact, are apt to get torn, so that it is always a matter of economy to have all such account-books bound in leather.

1569. Although the seven foregoing books are sufficient for all purposes of keeping accounts, in regard to the expenditure and income of woodlands, still, the book-keeping of the forester could not be said to be complete with them alone, inasmuch as, at the end of each year, he must render to his employer a correct and formal account of all the transactions he has performed during the year past. For this purpose we have in use other two books; one called "Comparative Statement as to Estimated and Actual Income and Expenditure," and another called "Statement of Income and Expenditure." A copy of the former is annexed.

1571. We shall now take a glance at the foregoing statement, with the view of giving a short explanation of what it is meant to represent, and show the use of keeping such a book. The object of it is to embrace, in one comprehensive statement, the transactions of each year, after they have been all performed in accordance with the scheme supposed to be drawn up at the beginning of the year, in the way shown in the statement called the "Estimate of the Probable Income and Expenditure, &c.," a copy of which has been given as the first book in this system of book-keeping. But it is designed not only to embrace all the transactions of the year, but also to compare the sums actually received and expended on each branch at the end of the year with those that were estimated as probable at the beginning.

1572. Taking a glance at the debtor or income side of the statement just given, we see that the first column indicates the different woods from which produce was sold, and the second column, the description of produce. The third column indicates the quantities of trees sold by public auction, and the sums actually realised for each sort and quantity, and this of course should correspond with the results stated in the public sales book. The fourth column, again, indicates the quantities sold by private contract, and the sums actually realised for each sort and quantity. This of course should correspond with the details and results of the private sales book, and with those detailed in the sales entered in the ledger. The fifth column shows the entire quantities sold, and the whole of the money realised for them, and into this column is entered the value of all plants that have been removed from the nursery to the enclosures.

1573. Under the great column, No. 6, the comparison betwixt the actual and estimated income is shown, and the difference betwixt them respectively. Thus, in the first column under No. 6, it is shown that the sum actually received for the 10,000 larch trees sold from the Hill of Bands, is £5480, in the second, that £5000 only was estimated as their value, and from the fourth, that they realised £480 over their estimated value; and so on with the other items detailed.

1574. The result of the debtor side of this statement is, that it is seen at a glance under column third, that £9654 was realised during the year from public sales, and under column fourth, £2427, 9s. 10d. from private sales. But besides this, it is shown under 1 of column six, that £12,525, 11s. 10d. was realised as the whole value of produce, of all sorts, during the year, and under 2 of column six, that only £11,850, 2s. was expected to be realised; while, under 5 of column six, it is brought out that £766, 9s. 10d. has been realised over and above what was expected at the beginning of the year, and as stated in the estimate of probable income and expenditure for the year.

1575. On the creditor or expenditure side of the statement, the same mode of comparison is followed in regard to the sums under the different branches there set forth; and as I have said so much in explanation of the income side, I think it unnecessary to enlarge in reference to the expenditure, as the different headings speak for themselves. I may, however, just make a short reference to one or two of the branches.

1576. Under the head "salaries and allowances," it will be seen that the actual expenditure at the end of the year was exactly the same as that estimated for at the beginning of it.

1577. Under the head "fencing," it is brought out that the paling which was erected on Braidwood Hill enclosure cost £6, 0s. 5d. more than was estimated for; that the stone dyke erected on Thorton Bridge enclosure cost £51, 6s. 3d. less than estimated; that the general repairs of fences cost £20, 6s. 8d. less than estimated; that the repairs of gates cost £4, 17s. more than estimated; and that, on the whole, the fencing cost £60, 16s. 6d. less than was expected at the beginning of the year.

1578. That some difference, less or more, will occur in all such estimates, must be expected by every judicious man, as it is not in the nature of things that, at the beginning of the year, when the works are merely in contemplation, the forester should know the exact sum that each is to cost. It is, therefore, not to be attributed to want of judgment in the forester, although he should be even 15 per cent from the estimate on some particular works, if, on the whole, he come near to the truth.

1579. Having made the foregoing remarks in reference to this statement, I shall now conclude by pointing out, that the result of the comparison of the actual and estimated expenditure, as set forth in reference to all the different branches, is, that while £3761, 4s. 10d. was allowed for them all, at the beginning of the year (see details under paragraph 1492), they cost in all only £3752, 19s. 9d., or £8, 5s. 1d. less than was expected.

1580. The advantages of keeping a book in which to register such a comparative statement in reference to each year's transactions, must appear evident to every one who has at all paid attention to the keeping of correct accounts of estate management. No proprietor ought to be without such a statement from his forester at the end of each year's transactions, as he can see at a glance from it whether his forester has realised the income he expected, and whether he has carried out the works he proposed at such a cost as he anticipated; and from having such, he can always look back upon it as a guide to himself in proposing such works for the future. But besides, the keeping of such a book as has been here exemplified, will compel the forester himself to act with judgment in all he undertakes, well knowing that his employer will call him to account for any very great difference that may arise, whether in reference to income or expenditure. The next book, and the last one I have to refer to, is that which shows the actual state of income and expenditure for the year. A specimen of this, grounded on the copies of books and statements already given, will be found on next page.

1582. Under paragraph 1581 of the statement just given, the sum of £12,209, 9s. 10d. is brought out as the gross amount which the forester is supposed to have received during the year, and for this amount, therefore, he has to account to his employer. I ought to remark here, however, that this amount of income is less than that stated in the comparative statement (under paragraph 1570), by £316, 2s. The reason of this is, that in the comparative statement, the latter sum is entered in the actual income as the value of plants supplied to the enclosures from the nursery. This amount, it must be kept in view, however, was not received by the forester, but was merely stated in the comparative statement, to show the real value of the plants reared in the nursery, and planted out by him. But, deducting this sum of £316, 2s. from the gross income of £12,525, 11s. 10d., stated as the gross income under paragraph 1570, we have exactly £12,209, 9s. 10d. as the real or actual income for which the forester is supposed to have to account, and this corresponds with the income stated under paragraph 1581.

1583. On the creditor side of the statement, the different accounts are branched, according to the work they have been paid for; and of course, the amount of all the vouchers for the different branches of accounts must correspond with the total of the sums paid out by the forester for the year, and as entered in his cash-book.

1581. LYNMORE WOODS

Dr.

RECEIPT AND EXPENDITURE, *from the*

	£	s.	d.	£	s.	d.
To RECEIPT—						
Sales of Produce by Public Auction.						
From sales of larch and pine timber, in the plantations of Gorry and Hill of Bands, on the 4th May 1860, as per public sales book, . . .	£9279	0	0			
From sales of oak timber in Adam's Wood, on the 24th August 1860, as per public sales book, .	375	0	0			
				£9654	0	0
Sale of Produce by Private Contract,						
As per private sales book, ...	2427	9	10			
				2427	9	10
Rent of saw-mills, for the year ended 30th April 1861, ...				110	0	0
Rent of cottages for the year ended 30th April 1861, ...				18	0	0
Carry forward,				£12,209	9	10

AND PLANTATIONS.

Cr.

30*th April* 1860 *to* 1*st May* 1861.

No. of Voucher.	Expenditure—	£	s.	d.	£	s.	d.
	Salaries and allowances—						
1.	John Baxter, forester, for year ended 30th April 1860,	£300	0	0			
2.	Ditto, allowance for horse, ditto,	30	0	0			
3.	George Gillian, assistant to forester, for year ended, ditto,	100	0	0			
4.	Ditto, allowance for horse, ditto,	30	0	0			
5.	William Turnbull, clerk to forester, ditto,	60	0	0			
6.	Peter Sangster, allowance for looking after western district, one year, ended ditto,	40	0	0			
7.	George Jopp, ditto eastern district, ditto,	40	0	0			
8.	Robert Bruce, ditto northern district, ditto,	40	0	0			
9.	Maxwell Hay, ditto southern district, ditto,	40	0	0	£680	0	0
Vouchers in Monthly Pay-List.	Pay-Lists of day-labour and piece-work, for the month ended 26th May 1860,	193	14	6			
	" 30th June "	386	15	6			
	" 28th July "	170	10	9			
	" 1st Sept. "	163	2	6			
	" 29th do. "	235	9	4			
	" 3d Nov. "	142	7	6			
	" 1st Dec. "	167	0	0			
	" 29th do. "	150	2	10			
	" 1st Feb. 1861,	96	15	7			
	" 2d March "	135	19	4			
	" 30th do. "	296	7	3			
	" 30th April "	141	18	7	2280	3	8
	Young trees for nursery—						
10.	John Stoddart, Muirhead,	57	12	9			
11.	James Maxwell, Newtown,	19	14	3			
12.	George Simpson, Rafford,	12	12	9	89	19	9
	Carriage of young trees—						
13.	Lachlan Grant, Newtown,	2	7	6			
14.	Wm. M'Kenzie, Lynstock,	5	19	3			
15.	George Sutherland, Mayen,	1	17	1	10	3	10
	Carpenter Work—						
16.	John Mathieson, Newlands,	5	18	0			
17.	Robert Welbeck, Bencroft,	4	6	0			
18.	Samuel Murison, do.	0	13	0	10	17	0
	Smithy Work—						
19.	Robert Dickson, Rosieburn,	4	8	6			
20.	Donald Fife, Craigstown,	5	17	0			
21.	Alexander Laing, Smiddyseat,	2	13	6	12	19	0
	Lodges, Repairs of—						
22.	James M'Kinnan, mason, Pitgair,	62	14	10			
23.	George Urquhart, carpenter, do.,	15	13	4			
24.	William Sim, painter, do.,	1	3	4	79	11	6
	Carry forward,				£3163	14	9

LYNMORE WOODS

Dr.

RECEIPT AND EXPENDITURE, *from the*

To amount brought forward,	£12,209 9 10
	£12,209 9 10

AND PLANTATIONS.

Cr.

30*th April* 1860 *to* 1*st May* 1861—(*Continued.*)

No. of Voucher.		£	s.	d.	£	s.	d.
	By amount brought forward,				£3163	14	9
	General Stationery—						
25.	Samuel Walker,	£1	3	6			
26.	Wm. Smith, jun.,	7	1	2			
27.	Robert Dunbar,	5	11	4			
28.	George Fowlie,	1	15	10			
					15	11	10
	Expenses on Sales of Timber—						
29.	George Ramsay, advertisements,	6	2	3			
30.	Wm. Walker, do.	6	12	9			
31.	Wm. Murison, sale dinners,	15	12	7			
32.	George Ramsay, printing catalogues,	6	5	6			
33.	James Skinner, auctioneer,	6	14	6			
34.	Do. do.,	3	3	0			
					44	10	7
	Implements, Ironmongery, &c.—						
35.	John Hanny,	3	19	4			
36.	Alexander Thomson,	3	3	2			
					7	2	6
	Travelling Expenses of Forester and Assistant—						
37.	John Baxter,	19	11	5			
38.	George Gillian,	11	4	1			
					30	15	6
	Criminal Prosecutions—						
39.	Walter Gregor,	27	5	6			
					27	5	6
	Keep of Forest Work-horse—						
40.	Robert Manfred,	7	10	0			
41.	James Strachan,	1	2	0			
42.	Thomas Low,	11	9	6			
43.	James Shaw,	6	8	6			
					26	10	0
	Wages of Carter—						
44.	James Parker,	30	0	0			
					30	0	0
	Saddlery—						
45.	George Yeats,	4	3	6			
					4	3	6
	Rates and Taxes—						
46.	William Inglis, assessor,	87	3	7			
					87	3	7
					3436	17	9
	1860.						
	Nov. 11.—By Cash remitted to J. E.,	4000	0	0			
	1861.						
	Nov. 20.—By do. do. do.	4000	0	0			
	„ 30.—By Balance on hand, as per Bank Book,	772	12	1			
					8772	12	1
					£12,209	9	10

1584. The first branch of accounts is that for "Salaries and Allowances," and for this there are nine vouchers in all. In making up this statement, the forester should number on the back each voucher with a number correspondent to that which he gives it in the statement, so that he can lay at once his hand upon it from its number, independent of its description on the back. The amount brought out as having been paid for salaries and allowances (£680), corresponds with that brought out for the same branch under paragraph 1570.

1585. The next branch of the account is that of "Day-Labour and Piece-Work," the vouchers for all of which are understood to be kept in the book called Pay-List of Day-Labour and Piece-Work, a copy of which is given under paragraphs 1513 and 1514. In this statement are embraced all accounts paid for Fencing, Draining, Planting, Hedging, Repairs of Water-Runs, Saw-Mill Dams, Roads, &c.; Felling and Preparing Timber, Stripping and Curing Bark, Thinning, Clearing, and Burning Rubbish, Pruning, and all Nursery Work; all as detailed under paragraph 1570 of the Comparative Statement of Expenditure.

1586. All the other branches of accounts detailed in this statement show for themselves, and are simply different accounts as paid by the forester during the year, and branched according to their characters, and numbered for convenient reference.

1587. From this statement it is brought out that the forester, during the year, is supposed to account and to show vouchers for having paid out in all, for the different works, the sum of £3436, 17s. 9d.; that he has paid his employer, at the dates mentioned, £8000; and that he has on hand at the time he is supposed to render this account, £772, 12s. 1d. All these sums added together, then, correspond with the sum of £12,209, 9s. 10d., stated as the gross income on the debtor side of the statement; which, therefore, shows that the transactions are correct.

1588. The sum of £3436, 17s. 9d., stated as the gross sum expended by the forester during the year, will be found not to correspond with the sum brought out as the total expenditure in the comparative statement under paragraph 1570, as in the latter, the sum of £316, 2s. is entered as the value of plants removed from the nursery, which sum, as I before stated, was not paid out by the forester, but merely entered to show the actual value of the plants. Both statements, however, will be found to correspond by deducting the sum last named from the gross amount set down as the actual expenditure under paragraph 1570; and with this explanation, I think I have said enough on the subject of book-keeping.

1589. The forester, it is understood, renders such a statement as has just been described, at the end of each year, to his employer, with all the vouchers for the different accounts ; and on rendering it, he should register a copy of it in a book for the purpose, so that he at all times knows what he has done and stated, and can refer to it when necessary.

1590. With such a set of account-books as I have given copies of and described, any forester may keep his business as well as any accountant could.

1591. There are other two books required—viz., the Nursery Book, and the Bank Book ; but the former is a mere keeping of the number of plants sent out and brought in, and is so simple, that any forester can sketch out such for himself. The latter, on the other hand, is a mere pass-book, kept between the banker and the party lodging the money, and need not be referred to here.

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